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NATURAL REGIONS, SUBREGIONS AND NATURAL HISTORY THEMES OF ALBERTA

A CLASSIFICATION

FOR PROTECTED AREAS MANAGEMENT

REVISED AND UPDATED

DECEMBER 1994

Alberta
ENVIRONMENTAL PROTECTION

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PARKS SERVICES

ALBERTA ENVIRONMENTAL PROTECTION

by

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July 1992

(Updated and Revised December 1994)

Reports In This Series

Report 1 **Natural Regions: A Framework For Alberta's Special Places (1993)**

This report is intended for broad public distribution and summarizes in plain language and graphic format the technical information in Reports 2 and 3 (24 pages). This report requires updating to incorporate the 20th sub-region.

Report 2 **Natural Regions, Subregions and Natural History Themes of Alberta: A Classification for Protected Areas Management (Revised September 1994).**

This report is the framework document for Alberta Parks Services system planning for protected areas. The report provides an overview of land classification in Alberta and the rationale for the Natural Regions Classification framework. The hierarchical framework of natural regions, subregions and natural history themes used for protected areas systems planning in Alberta is described. Level 1 natural history theme targets (measured in hectares) required to complete Alberta's endangered spaces network are provided. The report provides an up-to-date summary of the six natural regions and 20 subregions and associated Natural History Themes. The report includes an updated color map and a detailed glossary of technical terminology used in the report (approx. 75 pages). This report is based on the best available scientific information and will only be updated if future research demonstrates the need for changes to the framework.

Report 3 **Alberta Protected Areas Systems Analysis (1994). This report replaces Natural Regions and Natural History Themes: Targets for Alberta (December, 1992)**

For each subregion natural history theme targets are evaluated relative to existing protected areas. An overview of protected area needs for each subregion is provided (approx. 50 pages). This report will be updated periodically to reflect progress being made toward completing Albertas protected areas system.

Report 4 **Natural Regions of Alberta: Annotated Bibliography (January, 1993)**

This report is a reprint of the appendix of Achuff, P. L., J. Godfrey and C. Wallis. 1988. *A system planning natural history framework and evaluation system for Alberta Recreation and Parks*. Kanata Heritage Research report to Alberta Recreation and Parks, Edmonton (approx. 110 pages).

Note: These reports update and replace earlier reports prepared by Kanata Heritage Research prepared for Alberta Recreation and Parks in 1988 and subsequently revised in 1992.

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ACKNOWLEDGEMENTS

The revision of the natural regions classification was supported by the Alberta Park Services, Environmental Protection. Direction by K. Clifford, A. Landals and P. Lee is acknowledged. Appreciation is also due to the following people for their assistance in various ways: D. Downing, G. Newton, W. Nordstrom, W. Strong, and C. Wallis.

The 1993 amalgamation of the Natural Regions land classification framework with the Ecoregions of Alberta necessitated updates to the 1992 documents. These updates were undertaken by Dr. Peter Achuff.

Alberta Parks Services reorganized some of the information between the reports so that Report 3 "Evaluation" of Existing Protected Areas can be readily updated as new sites are added to the system.

1. INTRODUCTION AND BACKGROUND

1.1 Land Classification

Alberta encompasses a vast geographic range from the U.S. border at 49°N to the Northwest Territories at 60°N, and from the heights of the Continental Divide in the Rocky Mountains to the rolling prairies and boreal forest in the east. One of the main purposes of protected areas (provincial parks, ecological reserves, wilderness areas, natural areas) in Alberta is to conserve examples of the full array of this natural diversity. In doing so, it is necessary to divide the province, through the process of **land classification**, into units that reflect natural features. Such a classification is designed to organize and simplify information so that it can be used for a variety of planning and management purposes.

Land classification for protected areas should be based on natural or biogeographic features - geology, landform, hydrology, soils, climate, vegetation and animal life. When these features, both physical and biological, are considered as an integrated unit or holistically, they are termed an **ecosystem** or **landscape**. The classification frequently includes a hierarchy of units depending on size, scale, information available, and the purpose for the classification. Thus, geographic areas are commonly divided into a series of landscape types or ecosystem types that reflect overall patterns of landscape features.

The process of division 'from the top down' separates larger units into smaller ones based on differences. This process in land classification generally uses broad views of the landscape on air photos, satellite images or maps to divide larger, heterogeneous units into smaller, more homogeneous ones.

The complementary process of aggregating small, homogeneous units 'from the bottom up' into larger units requires extensive, detailed information on the area being classified. It is seldom used exclusively because such detailed information is usually not available. However, where parts of an area are known in sufficient detail, the information is used often as a check on the 'top down' process. In actuality, most land classifications use both processes in an iterative, back-and-forth checking manner (Hills 1976). These two approaches have been likened to "the blades of scissors, together cutting up experience into understandable pieces" (Rowe 1978).

However, classifications do not spring full-blown from the landscape. Decisions must be made by the classifier and the most important of these concerns the **purpose** of the classification. Different purposes will produce different classification.

1.2 Land Classification in Alberta

In Alberta two systems of ecologically-based land classification have been used by provincial government departments for broad-scale purposes. The first is the Natural Regions and Subregions classification initially developed by Achuff and Wallis (1977) for natural area and ecological reserve planning purposes. This classification was subsequently adopted by the Alberta Parks Service and was used as a natural history framework for a provincial system plan (Achuff et al. 1988). The system was used by the Alberta Parks Service for provincial parks, wilderness areas and ecological reserves purposes, and by the Natural and Protected Areas Program of Alberta Forestry, Lands and Wildlife for natural areas purposes. It has also being used by a number of non-governmental conservation groups in Alberta and ties in with the Terrestrial Natural Regions scheme of the Canadian Parks Service.

The other system is the Ecoregions of Alberta classification developed initially by Strong and Leggat (1981) and revised by Strong (1992). This system was used by the Land Information Services Division of Alberta Forestry, Lands and Wildlife and, to some extent, by the Alberta Forest Service and Alberta Fish and Wildlife. The system, in a modified form, has been tied in with an ecoregion classification for Canada (Ecoregions Working Group 1989). An Ecoregion, it should be noted, is a unit in the hierarchical scheme of ecological (biophysical) land classification as generally done in Canada (Wiken 1980).

There are many similarities between the two systems. However, the major difference is the emphasis in the Ecoregions classification given to climate as a determinant of ecosystem structure as expressed by vegetation (Strong 1992). The Natural Regions classification emphasizes overall landscape pattern which, in some cases, reflects climate but in others, reflects the predominance of geological or soil factors. Examples of these differences are discussed below in section 3.

The differences between these two systems of land classification reflect differences in purpose. The purpose of the Ecoregions scheme is "the classification and identification of Alberta's regional climate and vegetation" (Strong 1992). This purpose is related largely to agriculture, forestry, and wildlife production.

The purpose of the Natural Regions classification, on the other hand, is to account for the entire range of natural landscape or ecosystem diversity in Alberta and is related primarily to ecosystem and biodiversity conservation.

Thus, there is no **right** system. The differences between the two systems primarily reflect differences in purpose and, consequently, criteria used. The Natural Regions system emphasizes overall landscape pattern and best represents the ecosystem and biodiversity elements of importance to protected areas.

However, the differences between the two systems are also due to some degree to differences in information. Many parts of Alberta are still relatively poorly known and the revised Ecoregions classification (Strong 1992) contains information that is useful in revising the Natural Regions system. Wherever logical, subregional boundaries have been modified to correspond to ecoregional boundaries.

An important source of new information for the southeastern boreal forest is a study of significant natural features (D.A. Westworth and Associates Ltd. 1990) in which the author participated. The study involved a systematic evaluation, using air photos, aerial overviews, and ground checking, of a large part of the boreal forest in Alberta.

Information from the revised Ecoregions classification and other sources, is discussed below.

1.2.1 Grassland Natural Region

The Mixedgrass prairie of southeastern Alberta has been recognized by Strong (1992) as Dry Mixed Grass and was previously termed "Short Grass" (Strong and Leggat 1981). Strong's boundary largely corresponds with that recognized here except for the Gleichen area and south where Strong's boundary follows the Brown Chernozem zone line which is east of the boundary recognized here for the Mixedgrass Subregion.

Strong's (1992) "Mixed Grass Ecoregion" is essentially the area occupied by the Dark Brown Chernozem zone. It corresponds to portions of the Mixedgrass and Northern Fescue subregions recognized here. Strong (1992) does not recognize a fescue grassland between the mixed prairie and the aspen parkland. The existence of a northern fescue grassland is well documented by many workers (Cottonwood Consultants 1986; Coupland 1961; Looman 1969, 1979, 1980, 1981, 1982; Moss 1955; Moss and Campbell 1947; Wallis and Wershler 1985) and is recognized here as the Northern Fescue Subregion. It should be noted that Strong's (1992) "Fescue Grass Ecoregion" is essentially the same as the Foothills Fescue Subregion recognized here.

Thus, Strong's (1992) divisions are essentially along soil zone lines - Brown Chernozem = Dry Mixed Grass, Dark Brown Chernozem = Mixed Grass, and Black Chernozem = Fescue Grass. This division gives little weight to vegetation communities and places northern fescue grasslands in the Aspen Parkland Ecoregion by moving the Aspen Parkland boundary south. While recognizing the continuum in conditions in the grasslands of southern Alberta, it seems most useful to recognize the vegetation differences and to split the Dark Brown Chernozem zone. Thus, a Mixedgrass Subregion with Brown and Dark Brown Chernozems as well as a Northern Fescue Subregion with Dark Brown and Black Chernozems is recognized.

As noted above, fescue grasslands along the foothills are recognized in both systems. However, it seems best to recognize the distinctive character of these fescue-oatgrass communities, which have affinities with cordilleran and foothill vegetation to the west and south, and term them "Foothills Fescue." An additional difference is Strong's (1992) placement of the grasslands on the lower slopes of the Cypress Hills and Sweetgrass Hills in the Mixed Grass Ecoregion. These grassland have greater affinity to the Foothills Fescue Subregion and are better placed there.

1.2.2 Parkland Natural Region

As noted above, Strong (1992) does not recognize a northern fescue grassland unit and extends the boundary of the Aspen Parkland Ecoregion south to include much of what is here recognized as the Northern Fescue Subregion. Otherwise, Strong's (1992) Aspen Parkland Ecoregion is essentially the same as the Central Parkland Subregion recognized here.

The distinctive conditions of the Foothills Parkland Subregion recognized here are also acknowledged by Strong (1979, 1992) but this area is included mostly within his Aspen Parkland Ecoregion. This Subregion occupies a narrow, discontinuous band along the southern foothills but contains a distinctive vegetation and flora and it seems most useful to recognize it here at the subregional level.

The Peace River Parkland Subregion recognized here was previously recognized, in part, by Strong (Strong and Leggat 1981) and also Moss (1952, 1955) but has been revised to be included with the Low Boreal Mixedwood Ecoregion (Strong 1992) primarily on the basis that the climate does not differ and that the vegetational differences are the result of soil conditions. The differences in purpose and criteria between the two classification systems mentioned above in section 1 are important here. The Ecoregion system emphasizes climate while the Natural Regions/Subregions system

considers overall ecosystem characteristics. Thus, while the occurrence of the Peace River parkland may be due primarily to edaphic conditions, these are sufficient to merit its recognitions as a distinctive unit for protected areas planning purposes.

1.2.3 Foothills Natural Region

The former division of the Foothills Natural Region into Main and Outlier sections has been revised to Upper Foothills and Lower Foothills Subregions that are essentially the same as Strong's (1992) Upper Boreal-Cordilleran and Lower Boreal-Cordilleran Ecoregions. The previous division emphasized the differences in bedrock geology (Main Foothills - folded and faulted vs. Outlier Foothills - flat-lying) and floristics (Main Foothills - more cordilleran influence vs. Outlier Foothills - more boreal influence). The present division emphasizes vegetational differences and is perhaps most useful, although the differences between Main and Outlier portions remain.

Strong (1992) includes the Boreal-Cordilleran ecoregions within the Boreal Ecoprovince although he obviously recognizes the transitional nature between the boreal forest and the Rocky Mountains. Here it is thought to be more appropriate to recognize this area as a distinct Natural Region, the equivalent of an Ecoprovince, rather than submerge it in the boreal forest. The Foothills occupy a large area of Alberta and are as distinctive geologically, physiographically and vegetationally as the other Natural Regions recognized here.

1.2.4 Rocky Mountain Natural Region

There is much similarity between the two systems in the classification of the Rocky Mountains; both recognize Montane, Subalpine and Alpine units. Strong's (1992) revised concept of the Montane brings it much more in line with the area recognized here. This includes recognizing portions of the Cypress Hills as Montane and expanding the extent of the Montane in the southwestern corner of the province. However, portions of the Foothills Parkland Subregion have been included by Strong (1992) as part of the Montane Ecoregion. Overall though, the two systems are essentially the same.

1.2.5 Boreal Forest Natural Region

The boreal forest occupies the largest portion of Alberta and encompasses a large array of conditions that often vary in a gradual and subtle manner. Thus, while its large size and variation require division into subunits, the gradual continuum of features and limited information for many areas make classification difficult and sometimes arbitrary. Despite these problems, there is much agreement between the Ecoregions (Strong 1992) and Natural Regions classifications.

There is essential similarity between the Subarctic Subregion recognized here and the Boreal Subarctic Ecoregion (Strong 1992), and between the Boreal Highlands Subregion and the High Boreal Ecoregion, minus the area recognized here as the Athabasca Plain and Kazan Upland subregions (see section 2.6 below).

The Peace River Lowlands Subregion recognized here is included in the Mid Boreal Mixedwood Ecoregion (Strong 1992). This division is made on the basis of overall landscape characteristics. The Peace River Lowlands are primarily a fluvial landscape in which fluvial processes have produced predominant landforms, soils and vegetation communities that are distinctive from surrounding landscapes or ecosystems even though climatic and "reference site" conditions may be similar. This difference has been recognized by other workers (Rowe 1972).

The Wetland Mixedwood Subregion recognized here is included in the Mid Boreal Mixedwood Ecoregion of Strong (1992). The Subregion contains a greater proportion of wetlands, both peatlands and willow-sedge complexes on mineral soil, and more upland black spruce forest than more southerly parts of the Mid Boreal Mixedwood (recognized here as the Central Mixedwood Subregion). This perhaps reflects the more rigorous, cooler climate and a lower moisture deficit. The differences are subtle; the distinction is perhaps tenuous and needs further examination, although it has been recognized by Rowe (1972) as the Hay River Mixedwood.

The considerable remainder of Strong's (1992) Mid Boreal Mixedwood Ecoregion (i.e. minus the areas recognized here as Peace River Lowlands and Wetland Mixedwood subregions), plus a portion of Strong's Low Boreal Mixedwood Ecoregion along the Peace River, is considered here as the Central Mixedwood Subregion. It corresponds closely to the central concept (aspen-white spruce mixedwood forest with Gray Luvisols) of the Low Boreal Mixedwood Ecoregion.

The Dry Mixedwood Subregion recognized here corresponds largely to the southeastern portion of the Low Boreal Ecoregion (Strong 1992). The northwestern part of the Low Boreal Ecoregion is included here partly within the Peace River Parkland Subregion and partly within the Central Parkland Subregion. Recognition of the Peace River Parkland arises from recognizing overall landscape pattern rather than emphasizing climate as discussed above in section 2.2.

1.2.6 Canadian Shield Natural Region

The two Natural Subregions recognized here, Athabasca Plain and Kazan Upland, as the Canadian Shield Natural Region are included by Strong (1992) as part of the High Boreal Mixedwood of the Boreal Ecoprovince. This difference stems primarily from the importance attached by Strong (1992) to climatic criteria and the reference site concept.

While there may be a similarity in climate between these Subregions and others of the boreal forest and while the vegetation communities of reference sites on "deep, well to moderately well drained, medium textured soils" (Strong 1992) may be similar, the overall landscape or ecosystem patterns are very different. Strong (1992) recognizes these differences at the Ecodistrict level (Kazan Upland = 12KU, Athabasca Plain = 12SP).

However, for protected areas purposes it is most useful to recognize the Canadian Shield as a distinctive Natural Region and divide it into two Subregions. Recognition at this level accords both with popular perceptions of major divisions of the province and with previous work (e.g. Rowe 1972).

1.2.7 Amalgamating the Two Systems

The merits of merging the two land classification systems have been recognized for some time. With the integration of Alberta's resource management agencies in the Department of Environmental Protection this became a high prior ity in order to enhance efficiency, effectiveness, and coordination within the department.

In 1993 a task force was struck with staff from the various services in Environmental Protection along with Agricul ture, Food and Rural Development to merge the two classifications. Input was also provided by private experts in the field and by Agriculture Canada who were facilitating discussions in western Canada toward achieving a common base map for Canada-wide state of the environment reporting.

In merging the two classifications the decision was made to retain the natural regions and subregions terminology because of its plain language. Reports using this terminology have been widely distributed to the public and within Alberta's school systems. Boundaries of many of the subregions were adjusted based on up-to-date scientific re search carried out to refine the former ecoregions maps. Lines on the Alberta map now meet those of adjacent jurisdictions at the provincial border.

At the request of Agriculture, Food and Rural Development the mixedgrass subregion was subdivided into two subregions: mixedgrass and dry mixedgrass. Based on their field research the western portion of the mixed grassland has better soils, and more precipitation resulting in higher productivity of natural rangeland. Subdivision of the mixedgrass on the basis of productivity will facilitate the preparation of better range management guidelines that recognize these differences.

The product of merging the two land classification systems "Natural Regions of Alberta" is being used by the Depart ment of Environmental Protection as a framework for:

(1) Ecosystem management
(2) State of the environment reporting
(3) Resource accounting
(4) Integrated resource planning
(5) Special Places 2000

Maps are available at a scale of 1:1,000,000 as well as an 8 1/2 x 11 format. A summary report has been prepared to accompany the maps.

The new amalgamated map recognizes six (6) Natural Regions and 20 subregions. The Ecoregions land classification will continue to be used for agriculture, forestry and other purposes as appropriate. This classification system is now based on 20 ecoregions which are identical to 20 subregions. Finer units are identified using ecological land classifica tion methodologies and terminology.

Systems planning for Special Places 2000 including provincial parks, natural areas, ecological reserves and wilder ness areas will be based on the six (6) natural regions and 20 subregions. Finer levels of resolution will be achieved by using natural history theme methodologies and terminology.

2. NATURAL REGIONS CLASSIFICATION

2.1 The Classification of Natural Regions and Subregions in Alberta

Natural Regions (Table 1) are recognized on the basis of broad differences in landscape patterns, especially the broad vegetational, soil and physiographic features, for example grassland vs. parkland vs. forest, Chernozemic soils vs. Luvisolic soils, or mountains vs. foothills vs. plains. These features also reflect broad patterns of climate and geology. To a lesser extent, wildlife features are used, although wildlife occurrence patterns are usually not as distinc tive or useful as soil, physiographic and vegetation patterns.

In Alberta, six Natural Regions are currently recognized (Achuff 1992): Grassland, Parkland, Foothills, Rocky Moun tain, Boreal Forest, and Canadian Shield. The distinguishing and typical features of each are described briefly below in section 2. The six Natural Regions are divided into 20 Subregions (Table 1) based on recurring landscape patterns relative to other parts of the Natural Region. Each Subregion is described briefly in section 2.

The features and landscape patterns used to recognize Subregions are of a finer degree and spatial scale than those used to recognize Regions. Fofr example, the Grassland NaturalRegion is divided into four Subregions (Dry Mixedgrass, Mixedgrass, Northern Fescue, and Foothills Fescue) on the basis of various differences in the vegetation communities, soils and climate (Table 2).

Table 1: Natural Regions and Subregions of Alberta

Region	Subregion	Area (Sq. km)	Subregion as % of Alberta
Grassland	Dry Mixedgrass	46975.90	7.09%
	Mixedgrass	19176.65	2.89%
	Northern Fescue	15384.61	2.32%
	Foothills Fescue	1488.27	2.25%
	Subtotal	96425.43	14.54%
Parkland	Central	53413.17	8.06%
	Foothills	4402.26	0.66%
	Peace River	4664.60	0.70%
	Subtotal	62480.03	9.42%
Foothills	Lower	65505.07	9.88%
	Upper	29285.16	4.42%
	Subtotal	94790.23	14.30%
Rocky Mounatain	Montane	5986.96	0.90%
	Subalpine	25764.46	3.89%
	Alpine	14515.70	2.19%
	Subtotal	46267.12	6.98%
Borel Forest	Dry Mixedwood	100647.48	15.18%
	Central Mixedwood	154595.03	23.32%
	Wetland Mixedwood	38438.19	5.80%
	Boreal Highlands	21236.46	3.20%
	Peace River Lowlands	10045.85	1.52%
	Subarctic	22001.36	3.32%
	Subtotal	346964.37	52.34%
Canadian Shield	Athabas ca Plain	7092.92	1.07%
	Kazan Upland	8927.88	1.35%
	Subtotal	16020.80	2.42%
	TOTAL	662947.98	100.00%

Produced by Alberta Parks Services, Management Support Division. 1994

Table 2: Example: Differences among the Subregions of the Grassland Natural Region

Subregion	Vegetation	Soils	Climate
Dry Mixedgrass western wheatgrass blue grama	spear grass Chernozems, Solonetzics	Brown few chinooks	warmest & driest
Mixedgrass northern wheat grass	porcupine grass Chernozems	Dark Brown more chinooks	cooler & moister
Northern Fescue porcupine grass	rough fescue june grass Solonetzics	Dark Brown & Black Chernozems,	colder & moister few chinooks
Foothills Fescue oatgrasses	rough fescue Idaho fescue few Solonetzics	Dark Brown & Black Chernozems	more chinooks milder winters

The specific criteria used to make the divisions into Subregions vary among Regions because different patterns of features are important in the natural character of each Region. All, however, reflect significant differences in landscape or ecosystem type.

2.2 Natural History Theme Evaluation System

A three level system of natural history Themes has been developed to provide as little or as much detail as is required for public communications and planning. The system follows that adopted in 1988 by Achuff et al. for parks system planning purposes. It is based on current landscape/ecosystem complexes and incorporates Themes that are both **representative** (typical or widely distributed features) and **special** (unique or atypical features). Regardless of level, all Themes are considered important and worthy of representation within a protected areas system. Ecosystem dynamics are recognized through the incorporation of fire, grazing and flood factors. Alberta's system has been developed and refined over the last 15 years and has been held up by the Canadian Council on Ecological Areas (1992) as a national model for representation gap analysis. The Theme system has been combined with the Natural Regions and Subregions classification to form a five level hierarchy for protected areas planning (Table 3).

Table 3. Natural Diversity Classification Hierarchy for Protected Areas Planning in Alberta.

Classification Hierarchy	Example 1	Example 2
NATURAL REGION (broad geographic region)	**GRASSLAND**	**BOREL FOREST**
↓	↓	↓
SUBREGION (narrowly defined geographic region within a Natural Region)	**MIXED GRASSLAND**	**SUBARTIC**
↓	↓	↓
LEVEL 1 THEME (broad landscape type within a Subregion)	**SANDY UPLAND-DUNE FIELD**	**ORGANIC WETLAND**
↓	↓	↓
LEVEL 2 THEME (broad habitat/vegetation type within a Level 1 Theme)	**ACTIVE SAND DUNE**	**BLACK SPRUCE FOREST**
↓	↓	↓
Level 3 Theme (specific geologic fethure, plant community or species within a Level 2 Theme)	**Parabloic Dune**	**Black spruce-Cloudberry Community Type**

2.2.1 Theme Levels and Consistency

Level 1 Themes are broad, significant, easily recognizable landscape types within a Subregion that contain a complex of physical and biological features that are apparent even to untrained observers. The detail found in Level 1 Themes is useful for explaining broad systems planning concepts to a variety of non-technical people, including the general public, politicians, and senior managers. Increasing levels of detail allow more technical users to ensure that there is adequate representation of the complete range of natural diversity.

Level 1, 2 and 3 Themes are based on:

1. an extensive review of the geological and ecological literature;

2. the collective experience from numerous decades of research by several authors (P. Achuff, J. Godfrey, C. Wallis, C. Wershler) of Alberta protected areas systems planning documents; and

3. discussions with other protected area managers and systems planners within various government and non-government agencies.

Within the Subregions, each of the 20 Level 1 Themes represents a significant and highly visible landform/ecosystem complex — a grouping of habitats and features whose characteristics are obvious. The Level 1 Themes typically occupy more than 1% of the landscape within each of the five major Level 1 Theme groupings (Non-sandy Upland, Sandy Upland, Valley/Ridge, Wetland and Glacier/Snowfield). Level 1 Themes can be further divided into Level 2 and Level 3 Themes, each giving finer levels of resolution (Table 4).

Level 1 Themes were developed from a detailed understanding of the relationship of landforms to various lifeform complexes.

Each Level 2 Theme is primarily a broad vegetation/habitat type and is also distinctive and relatively easy to recognize.

Level 3 Themes include more narrowly defined features including very specific plant community types, microhabitats for less common species, individual species, and specific landforms. Recognition of the differences between various Level 3 Themes often requires considerable training and experience in ecology and landform identification. Level 3 Themes are equivalent to the 'element' level used in other protected area planning systems, e.g. U.S. Nature Conservancy and some provinces in Canada.

Table 4. Natural History Theme Levels

increasingly popular and broad concepts ←				→ increasingly technical and detailed
LEVEL 1		**LEVEL 2**		**LEVEL 3**
Themes:				
- major, visible landform/lifeform complexes		- broad habitat types - soils great groups - highly visible and extensive surgficial geology components		- community types - specific wildlife habitiats - soil subfroups -bedrock types
- significant major ecosystems		- distinctive vegetation assemblages and habitat		- rare plant species - rare animal species
Sizes:				
- larger area needed for representation				- smaller area needed for representation
Evaluation:				
- broad remote sensing and regional gelogy and soils maps		- reconnaissance field studies; large scale erial photographyand		- detailed field studies

Although there is considerable consistency from Subregion to Subregion, some Themes are recognized at different levels across the Subregions due to their varying landscape significance or comparative rarity in one Subregion compared to another:

1. Springs are considered significant at Level 1 in much of the Parkland and Grassland; however, within the Boreal Forest, they are less distinctive (or perhaps more poorly described) and are positioned in Level 2.

2. Bedrock has a pervasive influence on the biological patterns on the Kazan Upland and, although bedrock is prominent in other Subregions, including the Rocky Mountains, it is not considered as biologically significant as in the Kazan Upland — as a result, bedrock appears at Level 1 in the Kazan Upland and at Level 2 in the Rocky Mountains.

3. Protected and Exposed Slopes are important and visible in plains landscapes but the same does not apply in Mountains and Foothills where different Level 1 and 2 Themes are used in defining the natural diversity.

4. Shallow and Deep Marshes do occur outside the Parkland and Grassland Natural Regions, but their diversity and biological importance is significantly less in the other four Natural Regions. As such, there is greater Level 1 Theme diversity of marsh types in the Parkland and Grassland Natural Regions. In other regions, these wetland types are incorporated under Wetland-Mineral and Level 2 Themes.

5. Lake is not represented at Level 1 in the Peace River Lowlands. There is a large lake in the Subregion but it is considered part of a Special Theme - Peace-Athabasca Delta.

There is also some overlap of Themes between Regions and Subregions. For example, many of the wetland types are similar across the Parkland and Grassland Regions, although their relative proportions in the landscape may be quite different.

To ensure that all aspects of natural diversity are addressed, **Special** appears as a broad Level 1 Theme in all Subregions but the specific components are often not significant until Level 2 or 3. These Special Themes relate to features that are unique or atypical, characteristically occupying very limited areas of the landscape. There are a few instances where Special Themes become significant at Level 1. A classic example is the Waterton-Crowsnest Ecosystem within the Rocky Mountain Natural Region and its Subregions. In the Waterton-Crowsnest area, there are numerous species and plant communities that do not occur in other Rocky Mountain areas to the north. Habitat is provided for many species that occur nowhere else in Canada. It is this aggregation of "atypical" or rare species and communities that mandates the placement of this and similar special features at Level 1. This Level 1 Special Theme can be further subdivided into Level 2 and 3 Special Themes.

While Special Themes are included in this summary, a detailed evaluation and identification of Special Themes has never been done for Alberta. This summary focuses on Representative Themes and only includes some of the more significant Level 1 and 2 Special Themes that have been identified to date.

2.3 Protected Area Targets

Protected Areas are places that are explicitly legislated and managed to protect important natural features. They play an important role in conserving biological diversity, i.e. the structural and functional variety of life forms at genetic, species, community and ecosystem levels. While there is an emphasis in this classification-evaluation system on biological diversity, often referred to as biodiversity, there are also non-biological landscape features of interest to the protected area system. These landscape features combined with the biodiversity constitute Alberta's overall natural diversity. The targets developed for Alberta apply to both natural diversity and biodiversity.

The Global Biodiversity Strategy (World Resources Institute 1992) suggests that all jurisdictions should review their existing and proposed protected areas to evaluate their status, needs and effectiveness to ensure that they are part of a carefully designed network of protected areas that can encompass the diversity of local and national conservation goals. A well-designed protected area system review should provide:

- a comprehensive statement of objectives and future directions for an evolving network of protected areas
- an assessment of the existing system's viability and completeness
- a procedure for systematically identifying additional areas required for meeting conservation objectives
- a clear statement of priorities and a plan of action for achieving conservation objectives

The Convention on Biodiversity (UNEP 1992), of which Canada is a contracting party, states that each contracting

party shall:

- develop plans or programmes for the conservation and sustainable use of biological diversity
- identify components of biological diversity important for its conservation and sustainable use
- establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity
- develop guidelines for the selection, establishment and management of protected areas or areas where special measures need to be taken to conserve biological diversity

The Canadian Environmental Advisory Council (1992) outlined five steps that can be used to identify and establish a network of protected areas:

- identify major natural regions and establish a system of parks and protected areas that represents the natural features in each region
- establish as a priority, large, major ecosystem reserves within each natural region, including a continuum of many habitat types and preserve the most biologically productive and diverse examples
- establish smaller protected areas that supplement and complement the major conservation reserves by protecting additional habitat types or by covering regional variants of habitat
- include areas that provide recreational, educational or research facilities, or that protect special interest, scenic or wilderness landscapes
- include some small reserves to protect specific sites such as nesting areas of important species, caves, wetlands or special geological features

2.3.1 Alberta's Approach

Alberta Environmental Protection has identified four program objectives related to natural resource conservation and use within the ministry's conservation-outdoor recreation system:

Protection - preservation and protection of a system of representative, special and outstanding natural landscapes and features.

Outdoor Recreation - provision of a variety of intensive and dispersed outdoor recreation opportunities.

Heritage Appreciation - provision of opportunities to explore, understand and appreciate the natural heritage of Alberta.

Tourism - encouragement of residents and visitors to discover and enjoy the natural resources of the province.

This report establishes protected area targets (in sq. km) for each Level 1 Theme that are designed only to meet Alberta's protection objective — other rationales and approaches will be required for setting targets for Outdoor Recreation, Heritage Appreciation and Tourism. Some targets have been revised upwards from previous work by Achuff et al. (1988) while others have been revised downwards based on experience with using the system over the last four years and with new information that has become available. In 1987, the Brundtland Commission or World Commission on Environment and Development indicated approximately 12% of the landscape should be in some form of protection but did not specify how it should be distributed or what level of protection it should be afforded. Helliwell (1975) has suggested that 20% of all lands should be dedicated to some form of protection. Most authors indicate the need for large protected areas, replicate protected areas, and diversity within each protected area; however, the guidelines for optimum biological design still have many limitations (Shaffer 1985).

As with any numerical system, great care should be used in applying it to natural systems. This is to be used as a dynamic tool for sorting and priorizing and should not be used as an absolute and inviolable reference point. The targets are based on the assumption that lands specified for meeting those targets will have a prime function in ecosystem protection and will not be subject to significant recreation and tourism use. Significant recreation and tourism use will require larger land bases. More holistic approaches that integrate protected areas into the surrounding land base will always be required. The requirements of large carnivores and migratory birds and mammals can not be adequately addressed by these targets. Large wilderness areas in the order of 4,000 sq. km and larger are recommended for complete biodiversity and wilderness protection (Canadian Environmental Advisory Council 1991). Increasingly,

it is becoming necessary to influence external land management to ensure ecosystem integrity within protected areas. It should be pointed out that even a large area like Wood Buffalo National Park is not immune from external modification such as has occurred in the Peace-Athabasca delta following construction of the Bennett Dam hundreds of kilometres upstream in British Columbia.

2.3.2 Level 1 and 2 Theme Targets

Level 1 Theme targets (Table 5) indicate a desired area of protection that will be adequate to represent a considerable portion of Alberta's natural diversity — additional lands and management approaches are needed to adequately protect the full range of Alberta's natural diversity. They are a "best guess" based on a review of literature on conservation biology (see Achuff et al. 1988 for summary to that date; also Wilson and Peter 1988 and Office of Technology Assessment 1987) and an understanding of Alberta's ecosystems. The size of the targets for Level 1 Themes indicate the importance of various Themes to natural diversity representation as well as the areal extent of those Themes in the landscape of each Subregion. While they reflect areal extent, the targets are not in exact proportion to the areal distribution of other Themes in a Subregion. Some Themes are more diverse and important biologically, e.g. springs in the Dry Mixed Grassland Subregion.

Unless a protected area is large relative to the size of the Subregion, more than one area will be required to achieve adequate representation. These replicates serve to cover off some of the geographic variation within Subregions. Guidelines for this evaluation to achieve adequate representation for any Level 1 Theme are that, in addition to meeting the target area requirement, the Theme should be well-represented in more than 5 widely spaced small units meeting the minimum size criteria of 10 sq. km or more than 2 widely spaced large units greatly exceeding the minimum size criteria.

Table 5. Level 1 Natural History Theme Targets (Km^2)

Level 1 Themes			Grassland				Parkland			Foothills		Rocky Mountain			Boreal Forest						Canadian Shield	
			Dry Mbredgrass	Mbredgrass	Northern Fescue	Foothills Fescue	Central	Foothills	Peace River	Lower	Upper	Montane	Subalpine	Alpine	Dry Mbredwood	Central Mbredwood	Wetland Mbredwood	Boreal Highlands	Peace River Lowlands	Subarctic	Athabasca Plain	Kazan Upland
Upland	Non-Sandy	Glacial Lake Bed	200	25	100	25	250	25	50						250	250			100			
		Ground Moraine	200	50	100	100	250	100							250	400	250	250		250		
		Hummocky Moraine	200	50	100	25	250								250	400	250	250				
		Bedrock																				100
Upland	Sandy	Sandy Plain	200	25	25	25	250								250	400	150				100	100
		Dune Field	200	25	25		100								250	400					100	
		Kame/Moraine Complex					100														100	
Valley/Ridge		Exposed Slope	100	25	25	10	25	10	25						100	100						
		Protected Slope	25	25	10	10	25	10	25						100	100		100		250		
		Floor/Stream	100	25	25	25	25	25	10	100	100	100	100	100	250	250	100	150	100		10	10
		Ridge/Valley Wall				25		25		500	500	500	500	500								
		Springs	2.5	2.5	2.5	2.5	2.5	2.5														
Wetland		Wet Meadow	10	2.5	10	10	10	10	10													
		Shallow Marsh	2.5	2.5	10	10	10	10	10													
		Deep Marsh	2.5	2.5	2.5	2.5	10	10	10													
		Alkali Wetland	10	2.5	2.5		10															
		Mineral								250	50	10	25	25	100	400	250	100	100	250	25	25
		Organic								250	50		10		100	400	250	250	100	250	25	25
		Lake			10		100		10	25	10	10	10	10	100	400	250	25		25	25	100
Glacier/Snowfield														10								
TOTALS			1253	263	448	270	1418	228	150	1125	710	620	645	645	2000	3250	1500	1125	400	1025	385	360
Target as % of SubRegion			2.7%	1.4%	2.9%	1.8%	2.7%	5.2%	3.2%	1.7%	2.4%	10.4%	2.5%	4.4%	2.0%	2.3%	3.9%	5.3%	4.0%	4.7%	5.4%	4.0%

3. NATURAL REGIONS AND SUBREGIONS DESCRIPTIONS

The descriptions of the Natural Regions and Subregions in this portion of the report largely follow those done previously by Achuff et al. (1988) but have been modified to account for new information and the new classification structure. Information sources used are listed in section 5 below.

3.1 Grassland Natural Region

The Grassland Natural Region occupies a broad area of southern Alberta and extends west to the Rocky Mountains and north to the southern edge of the Parkland Natural Region in central Alberta. The region is a flat to gently rolling plain with a few major hill systems. Most of the bedrock is covered with extensive, thick glacial till deposits. The diversity of the uplands is increased by numerous areas of fine-textured materials laid down in proglacial lakes and coarse-textured deposits in dune fields and outwash plains, both of which are associated with proglacial lake basins.

Rivers in the Grassland Natural Region are part of either the Saskatchewan River or Missouri River systems. Where valleys are carved deeply into bedrock, badlands have developed. Numerous coulees and ravines are associated with these river valley systems. Seven exposures of igneous rock, all within the Milk River drainage, are the only igneous exposures in the grasslands of western Canada. With the exception of these isolated igneous outcrops, bedrock exposures are all of sedimentary rocks and commonly occur along stream valleys.

The Grassland Natural Region contains four Subregions - Dry Mixedgrass, Mixedgrass, Northern Fescue, and Foothills Fescue. These Subregions are separated primarily on the basis of climatic, soils and vegetational factors. The Dry Mixedgrass Subregion is most extensive, occurring from the U.S. border, north and west to the Mixedgrass and Northern Fescue Subregions. The Mixedgrass Subregion occurs generally west of the Dry Mixedgrass Subregions. The Northern Fescue and Foothills Fescue Subregions occur in narrow belts along the northern and western margins of the Dry Mixedgrass and Mixedgrass Subregions. Although not shown on the Natural Regions Map, there is a disjunct occurrence of Foothills Fescue in the Cypress Hills at higher elevations within the mapped Mixedgrass Subregion boundary. More research is needed to accurately delineate the boundary between the Mixedgrass and Foothills Fescue in this area.

3.1.1 Dry Mixedgrass Subregion

Geology and Landforms
The topography of the Dry Mixedgrass Subregion is generally subdued with only a few minor uplands. The predominant landform is a low-relief ground moraine but there are significant areas of hummocky moraine, glaciofluvial outwash, glaciolacustrine sand plains, fine-textured glaciolacustrine lake deposits, and eroded plains. Elevations range from 600 m near Empress to more than 1300 m on the lower slopes of the Cypress Hills, Sweetgrass Hills. Although permanent streams are relatively rare, the ones that do exist are well defined. The Subregion is drained by several major rivers that have carved deeply into the bedrock in some places. This has exposed Cretaceous shales and sandstones, creating extensive badlands in some areas. Drainage is to the Missouri River system via the Milk River and to the Saskatchewan River system via all of the other rivers in the subregion.

Climate
Climatically, the Dry Mixedgrass Subregion is the warmest and driest in Alberta. It has a typical continental climate with cold winters, warm summers and low precipitation. Because of the warm summer temperatures and a high average wind speed, the rate of evaporation is high temperature is about 16^0C.

Total annual precipitation is typically around 260-280 mm and summer precipitation is lowest of any Subregion in Alberta. Compared to other Subregions, the Dry Mixedgrass Subregion has a high year-to-year precipitation variability. Spring is the wettest season with about two-thirds of the annual precipitation falling as rain, the peak occurring in June. The amount of snow cover is relatively low as is the number of days of continuous snow cover. Chinooks are most common along the western border of the subregion where there are more than 30 chinook days per year.

Soils
The characteristics soils of the Dry Mixedgrass Subregion are Dark Brown Chernozems. Brown Solonetz soils are common in the extreme southeast of the subregion and in a large area north of Dinosaur Provincial Park.

Vegetation
The name 'Mixedgrass' comes from the predominance of both short and mid-height grasses. The most widespread are the mid-grasses, *Stipa* spp. (spear grass), *Agropyron smithii* (western wheat grass) and *Koeleria micrantha* (June grass) and the short grass, *Bouteloua gracilis* (blue grama). *Agropyron dasystachyum* (northern wheat grass) and *Stipa curtiseta* (western porcupine grass) are characteristic of moister sites within the Subregion.

The majority of Mixedgrass vegetation is a *Stipa comata* - *Bouteloua gracilis* community with *Agropyron smithii* and *A. dasystachyum* also important in hummocky moraine areas. Fine-textured soils in glacial lake basins are characterized by the *Agropyron dasystachyum* - *Koeleria macrantha* (northern wheat grass - June grass) community. Solonetzic soils are typically occupied by the *Agropyron smithii* - *Bouteloua gracilis* (western wheat grass - blue grama) community.

The most widespread vegetation of sand dune areas is dominated by *Stipa comata* (spear grass), *Calamovilfa longifolia* (sand grass), *Koeleria macrantha* (June grass) and a variety of low shrubs including *Artemisia cana* (sagebrush), *Elaeagnus commutata* (silverberry), *Symphoricarpos occidentalis* (western snowberry) and *Rosa acicularis* (prickly rose).

Although much of the natural vegetation of the Dry Mixedgrass Subregion has been replaced by agricultural crops, extensive areas of native rangeland remain that are managed primarily for grazing by domestic livestock.

Wildlife
The Dry Mixedgrass Subregion contains the greatest number of animal species of any Subregion of the Grassland Natural Region. Many, especially those of sand dunes areas and the extreme southeastern part, occur no where else in Alberta. A few are absent or local in the rest of Canada.

On the upland plains, characteristic species of more heavily grazed areas include horned lark, McCown's longspur, chestnut-collared longspur and Richardson's ground squirrel. Species of lightly grazed areas include Baird's sparrow, Sprague's pipit, sharp-tailed grouse, and upland sandpiper. Western meadowlark and white-tailed jack rabbit are examples of species that tolerate a broad spectrum of grazing conditions.

Sage grouse, lark bunting, Brewer's sparrow and pronghorn show an affinity for sagebrush flats in the uplands and valley bottoms.

Sand plain and dune areas contain a number of rare and local species that are restricted to these habitats including Ord's kangaroo rat and western hognose snake. Wider ranging species that also occur here include sharp-tailed grouse, grasshopper sparrow and mule deer.

Riparian shrublands and forests support a diverse animal community. These include brown thrasher, gray catbird, yellow-breasted chat, mourning dove, northern flicker, house wren, northern oriole, deer mouse, Nuttall's cottontail, and white-tailed deer.

Rock outcrops and badlands are local but significant to a number of birds as nesting habitat including golden eagle, rock wren, ferruginous hawk, prairie falcon and mountain bluebird.

Marshes and wetlands are important habitat for many species of birds both breeding and migrating. Oxbow lakes of meandering streams provide key habitat for breeding amphibians including chorus frog, leopard frog, plains spadefoots and garter snakes.

3.1.2 Mixedgrass Subregion

The Mixedgrass Subregion is similar to the Dry Mixedgrass Subregion in many features. Those that differentiate it from the Dry Mixedgrass Subregion are emphasized here.

Geology and Landforms
The topography of the Mixedgrass Subregion is generally subdued with only a few minor uplands. The predominant landforms are ground moraine and hummocky moraine but there are important areas of glaciolacustrine sand plains, and fine-textured glaciolacustrine lake deposits.
The few permanent streams are well defined. Drainage is either to the Missouri River system via the Milk River or to the Saskatchewan River system.

Climate
The climate of the Mixedgrass Subregion is slightly moister and cooler than that of the Dry Mixedgrass Subregion. The mean annual temperature is about 5°C with a mean summer temperature about 15°C which is 1-2°C cooler than the Dry Mixedgrass Subregion. Winter temperatures in the Mixedgrass Subregion are 1-2°C warmer than the Dry Mixedgrass Subregion, with a greater frequency of chinook days (20-30 days) but with greater snow cover due to greater winter precipitation. Annual precipitation in the Mixedgrass Subregion is about 20% greater than for the Dry Mixedgrass Subregion.

Soils
The characteristic soils of the Mixedgrass Subregion are Dark Brown Chernozems as contrasted with the Brown Chernozems of the Dry Grassland Subregion. A few Black Chernozems occur on moister sites along the northern and western boundaries of this Subregion.

Vegetation
The vegetation of the Mixedgrass Subregion is similar to the Dry Mixedgrass Subregion. However, it is characterized by greater biomass production and a greater abundance of species that favour cooler and moister sites. Species such as *Stipa curtiseta* (western porcupine grass) and *Agropyron dasystachyum* (northern wheat grass) are more predominant than in the Dry Mixedgrass Subregion.

The majority of Mixedgrass vegetation is dominated by *Stipa comata* (spear grass) *Stipa curtiseta* (western porcupine grass) and *Agropyron smithii* (western wheat grass) and *A. dasystachyum* (northern wheat grass). A *Stipa curtiseta - Agropyron dasystachyum* (western wheat grass - northern wheatgrass) community occurs widely in mesic sites. Fine-textured soils in glacial lake basins are characterized by the *Agropyron dasystachyum - Koeleria macrantha* (northern wheat grass - June grass) community. On drier, exposed sites *Bouteloua gracilis* (blue grama) is more common.

Typical vegetation of sandy areas includes *Stipa comata* (spear grass), *Calamovilfa longifolia* (sand grass), *Koeleria macrantha* (June grass) and a variety of low shrubs including *Elaeagnus commutata* (silverberry), *Symphoricarpos occidentalis* (western snowberry) and *Rosa acicularis* (prickly rose).

Extensive Populus angustifolia (narrow-leaved cottonwood) woodlands occur on fluvial terraces of the Oldman, Belly, Waterton, and St. Mary's rivers and nowhere else in Canada.

Most of the natural vegetation of the Mixedgrass Subregion has been replaced by agricultural crops. The moister, cooler conditions of this Subregion, compared to the Dry Mixedgrass Subregion, are reflected in the greater productivity of rangelands which typically produce 25% more biomass.

Wildlife
The wildlife of the Mixedgrass Subregion is generally similar to but less diverse than that of the Dry Mixedgrass Subregion. Sandy areas are less common in this Subregion and extensive agricultural development has left comparatively little in natural habitat.

3.1.3 Northern Fescue Subregion

Geology and Landforms
Topographically, the Northern Fescue Subregion is characterized by gently rolling terrain. The most common landforms are low-relief ground moraine and hummocky moraine. Areas of outwash and sand plains, dune fields, and fine-textured glaciolacustrine deposits occupy a smaller but significant amount of the landscape. Eroded plains are important in the Sullivan Lake area. The lowest elevations are in the eastern parts of the Subregion.

Stream drainage is part of the Saskatchewan River system except for a large area of internal drainage in the Sounding Creek basin. Few stream valleys dissect the subregion but those with permanent flow are usually well-incised.

Climate
The climate of the Northern Fescue Subregion is transitional between the Mixedgrass and Central Parkland subregions. The mean May - September temperature is 14°C and the frost-free period is about 90 days. Mean annual precipitation is about 400 mm, with mean May - September precipitation about 280 mm.

Soils
The predominant soils are Dark Brown and Black Chernozems, with Brown Solonetz soils extending through the centre of the subregion in a broad band north of Hanna.

Vegetation
The grasslands of this subregion are dominated by *Festuca scabrella* (rough fescue), with *Koeleria cristata, Stipa curtiseta, Agropyron trachycaulum*, and *Helictotrichon hookeri* (Hooker's oatgrass) also important. Common forbs include *Anemone patens* (prairie crocus), *Artemisia ludoviciana* (prairie sagewort), *Cerastium arvense* (mouse-ear chickweed), *Linum lewisii* (wild blue flax), *Erigeron glabellus* (fleabane), *Galium boreale* (northern bedstraw), *Campanula rotundifolia* (harebell) and *Geum triflorum* (old man's whiskers).

Sand dune areas contain a mixture of *Festuca scabrella* grasslands with scattered shrubs of *Elaeagnus commutata* or thickets of *Rosa* spp. and *Symphoricarpos occidentalis*.

Wildlife
No animal species are restricted to the Northern Fescue Subregion and the composition is similar to that of the Mixedgrass Subregion. Generally, species that favour lightly to moderately grazed Northern Fescue grassland also favour lightly grazed Mixedgrass areas. These include Baird's sparrow, Sprague's pipit, upland sandpiper and sharp-tailed grouse. With heavy grazing, species more typical of the Mixedgrass Subregion increase, including horned lark, chestnut-collared longspur and Richardson's ground squirrel. Species more characteristic of the Northern Fescue Subregion than the Mixedgrass Subregion include savannah sparrow and thirteen-lined ground squirrel.

3.1.4 Foothills Fescue Subregion

Geology and Landforms
The Foothills Fescue Subregion occurs largely on morainal, glaciolacustrine and outwash deposits along the lower flanks of the Foothills Geologic Belt, the Porcupine Hills and onto the adjacent plains area. They occur primarily as a narrow band between the Mixedgrass Subregion and the Foothills Parkland Subregion, although in some areas Foothills Grassland merges directly into the Montane Subregion of the Rocky Mountain Region. There are disjunct areas on the lower slopes of the Sweetgrass Hills and on unglaciated loess deposits on the plateau of the Cypress Hills and immediately adjacent plains. The largest area of this latter type is on the Milk River Ridge.

Elevations in this subregion are much higher than in the other two grassland subregions. These range up to 1400 m in parts of the Cypress Hills.
A small portion of this subregion, in the Milk River Ridge and Cypress Hills areas, drains into the Milk River system. The rest is part of the Saskatchewan River system.

Climate
The climate of the Foothills Fescue Subregion differs from that of the Northern Fescue Subregion in having a greater frequency of chinooks and thus, a milder winter climate. There is also greater snowfall in late winter and early spring. The majority of precipitation falls during the growing season.

The mean annual precipitation ranges from 650 mm in the far south to about 500 mm in the north. The mean May - September precipitation is 290 mm. The mean May - September temperature is 11° to 13°C. The mean annual temperature is 3°C and the frost-free period averages 90 days.

Soils
The soils of this subregion are predominantly Dark Brown and Black Chernozems. Solonetzic soils are not important in the Foothills Fescue Subregion.

Vegetation
The Foothills Fescue grasslands are dominated by *Festuca scabrella* (rough fescue), *F. idahoensis* (Idaho fescue), *Danthonia parryi* (Parry's oatgrass) and *Danthonia californica* (intermediate oatgrass). Associated grasses include *Koeleria macrantha, Agropyron dasystachyum, Stipa curtiseta, S. columbiana* (Columbia needle grass), *Poa cusickii* (Cusick's bluegrass) and *Helictotrichon hookeri*. In the Cypress Hills, *Danthonia parryi* is rare and *Agropyron trachycaulum* is common. *Potentilla fruticosa* (shrubby cinquefoil) is a locally dominant shrub on rapidly drained sites along the foothills and on moist sites in the Cypress Hills, where it has increased with grazing pressure on the herbaceous species.

These grasslands have a greater variety and cover of forbs than does the Northern Fescue Subregion. Dominant species include.

Geranium viscosissimum (sticky geranium), *Anemone patens* (prairie crocus), *Lithospermum ruderale* (wooly gromwell), *Galium boreale, Thermopsis rhombifolia* (golden bean), *Artemisia ludoviciana* (prairie sagewort), *Hedysarum alpinum* (American sweet vetch), *Delphinium bicolor* (low larkspur), *Ranunculus cardiophyllus* (heart-leaved buttercup), *Dodecatheon* spp. (shooting star), and *Lomatium triternatum* (western wild parsley). *Balsamorhiza sagittata (balsam-root)* is characteristic of steep slopes of the foothills portion but is absent in the Cypress Hills.

Numerous species occur in the Foothills Fescue Subregion but not in the Northern Fescue Subregion. These include *Danthonia parryi, Agropyron spicatum, Festuca idahoensis, Stipa columbiana, Geranium viscosissimum, Lupinus sericeus, Besseya wyomingensis, Lomatium triternatum, Bupleurum americanum, Perideria gairdneri, Lithospermum ruderale* and *Conimitella williamsii*.

Populus angustifolia (narrow-leaved cottonwood) woodlands occur on fluvial terraces of the Oldman, Belly, Waterton, and St. Mary's rivers. These are generally less extensive than those in the Mixedgrass Subregion.

Wildlife
The fauna of the Foothills Fescue Subregion is depauperate compared with the other Subregions of the Grassland Natural Region. Upland wildlife is most diverse on the extensive plateaus of the Cypress Hills and the Milk River Ridge.

Wildlife in the forests and shrublands of the southwestern rivers is similar to that of the Milk River in the Mixedgrass Subregion. Along the western edge of the Foothills Fescue Subregion, some Rocky Mountain species occur.

3.2 Parkland Natural Region

The Parkland Natural Region, with the exception of the Peace River Parkland Subregion, forms a broad transition between the drier grasslands of the plains and the coniferous forests of the Boreal Forest and the Rocky Mountains. Except for small tongues extending a short distance into the northern U.S., this region is confined to the prairie provinces

of Canada. The Parkland Region occupies 10-15% of the landmass of Alberta, about 60,000 sq km. It consists of three Subregions - Central, Foothills and Peace River - which are separated on the basis of geographic location and major floristic differences.

The Parkland Natural Region is the most densely populated region in Alberta, with the greatest density in the Central Parkland Subregion. Land use has changed much of the native vegetation; the most extensive alteration has been in the Peace River Parkland and the least in the Foothills Parkland. Many vegetation types were not adequately documented before they were eliminated or greatly reduced.

3.2.1 Central Parkland Subregion

Geology and Landforms
The Central Parkland Subregion extends in a broad arc up to 200 km wide, north of the Grassland Natural Region and south of the Boreal Forest Natural Region. Surficial deposits range intermediate-textured hummocky and ground moraines to fine-textured glaciolacustrine deposits and coarse outwash, kame moraine, and dune field materials. Moraines are most widespread, with kame moraines locally extensive in eastern portions. The Neutral Hills are an excellent example of ice-thrust bedrock ridges.

Elevations range from just over 500 m where the Battle River enters Saskatchewan to around 1100 m in western portions. Numerous permanent streams, all part of the Saskatchewan River system, cut across the subregion. Numerous lakes are scattered throughout the subregion as well as a wide variety of permanent wetlands. Many of the lakes and wetlands are slightly to strongly saline.

Climate
The mean annual temperature for the Central Parkland Subregion is 2°C with a May - September average of 13°C. The frost-free period averages 95 days. Mean annual precipitation is 350-450 mm, and May - September precipitation averages 300 mm.

Soils
Black and Dark Brown Chernozems predominate under grassland vegetation while under the moister aspen woodlands Dark Gray Chernozems and Luvisolics are most common. Dark Brown Chernozems occur under woodland vegetation on sandy parent materials. A strip of Brown Solonetz soils runs through the centre of the subregion from Vegreville, through Beaverhill Lake and into the Sullivan and Dowling lakes areas.

Vegetation
Within the Central Parkland Subregion, there is a continuum from south to north of grassland with groves of aspen (*Populus tremuloides*), to aspen parkland, to closed aspen forest in the north. True parkland vegetation with continuous aspen forest broken by grassland openings is now very rare due to large scale clearing. In much of the rest of the Central Parkland Subregion, native vegetation is scarce because of the high productivity of the soils for agriculture. Consequently, most of the remaining parkland sites are on rougher terrain or sites with Solonetzic soils.

Two major forest types are recognized here on morainal and glaciolacustrine materials; a *Populus tremuloides* type and a *Populus balsamifera* (balsam poplar) type on moister sites in depressions and in the northern part of the subregion. Both are characterized by a dense, lush, species-rich understory. Species characteristic of the *Populus tremuloides* type include *Symphoricarpos albus* (snowberry), *Amelanchier alnifolia* (saskatoon), *Corylus cornuta* (beaked hazel), *Prunus virginiana* (choke cherry), *Cornus canadensis* (bunchberry), *Maianthemum canadense* (wild lily-of-the-valley) and *Schizachne purpurascens* (false melic grass).

Species characteristic of the moister *Populus balsamifera* forests include *Cornus stolonifera* (red osier dogwood), *Salix discolor* (pussy willow), *Ribes oxyacanthoides* (northern gooseberry), *Alnus crispa* (green alder), *Lonicera involucrata* (bracted honeysuckle), *Mertensia paniculata* (bluebells), *Petasites palmatus* (palmate-leaved coltsfoot), *Mitella nuda* (mitrewort) and *Actaea rubra* (baneberry). Species common to both types include *Rosa acicularis, Rosa woodsii* (woods rose), *Viburnum edule* (low-bush cranberry), *Rubus idaeus* (wild red raspberry), *Rubus pubescens* (dewberry), *Lonicera dioica* (twining honeysuckle), *Aralia nudicaulis* (sarsaparilla), *Agropyron trachycaulum* (bearded wheat grass), *Disporum trachycarpum* (fairy bells), *Pyrola asarifolia* (pink wintergreen), *Aster ciliolatus* (Lindley's aster), *Galium boreale* (northern bedstraw), *Epilobium angustifolium* (fireweed), *Lathyrus ochroleucus* (cream-colored peavine), *Vicia americana* (American vetch), and *Smilacina stellata* (star-flowered Solomon's seal).

The grassland vegetation of the 'parks' is essentially the same as that of the Northern Fescue Subregion. *Festuca scabrella* (rough fescue) dominates most sites with *Stipa curtiseta* (western porcupine grass) being important on south-facing slopes in the southern part of the subregion and on solonetzic soil areas. Other grasses of solonetzic areas are *Koeleria micrantha* (June grass) and *Agropyron smithii* (western wheat grass).

Shrub communities are more extensive in the northern portion of the subregion and often extend in belts outward from the forest communities. Major species are *Symphoricarpos occidentalis, Rosa* spp., *Prunus virginiana, P. pensylvanica, Amelanchier alnifolia* and *Elaeagnus commutata.*

Wildlife
The animals of the Central Parkland Subregion are a mix of elements of the Northern Fescue Subregion and the boreal mixedwood Subregions. At the southern edge of the Subregion, grassland species such as upland sandpiper, Sprague's pipit and Baird's sparrow occur but become less common further north. Along the northern boundary, boreal forest species such as woodchuck, broad-winged hawk and rose-breasted grosbeak are more common. Franklin's ground squirrel and piping plover range primarily in this Subregion. Species characteristic of forested uplands include red-eyed vireo, red-tailed hawk, least flycatcher, Baltimore oriole, yellow warbler, white-tailed deer, American porcupine, northern pocket-gopher and snowshoe hare.
Wetlands are more common in this Subregion than in the Grassland Natural Region and contain a wide variety of birds and amphibians.

3.2.2 Foothills Parkland Subregion

Geology and Landforms
The Foothills Parkland Subregion occupies a narrow band along eastern edge of the geological foothills from Calgary south to the Porcupine Hills, and from Pincher Creek south to the U.S. border in the Waterton Lakes National Park area. The topography is rougher than that of the Central Parkland Subregion, and elevations are higher, ranging to over 1300 m near Paine Lake. Numerous permanent streams occur and drainage is into the Saskatchewan River system.

Surficial deposits include extensive areas of hummocky and ground moraine as well as more restricted areas of outwash and glaciolacustrine deposits along valleys. Extensive river terraces occur in some areas.

Climate
Mean annual precipitation ranges from 650 mm in the far south to 500 mm in the northern part of the subregion. Mean May - September precipitation is 290 mm. The mean January temperature is -10°C and the mean July temperature is 14°C. The mean May - September temperature is 12-13°C and the frost-free period averages 90 days.

Soils
Predominant soils in the forested areas are Black Chernozems with Dark Brown and Black Chernozems in the grasslands. Regosolics occur on active stream floodplains while Gleysolics occur in wetland sites.

Vegetation
Foothills Parkland generally forms a narrow, transitional band between the grasslands of the Foothills Fescue Subregion and the forests of the Montane Subregion. As in the Central Parkland Subregion, there is a continuum from grassland with groves, to forest with grassy parks, to closed deciduous forest. Because of rapid topographic and climatic change, the transition occur over distances as small as one kilometre and rarely over more than five kilometres. This compression of the vegetational continuum results in small geographic areas being very diverse. Desiccation by wind and low precipitation appear to be the main factors determining the extent of this subregion. The northern boundary of this subregion has been placed near Calgary since this is apparently about the limit of a number of distinctive southwestern species. This is the most northerly place where *Lupinus* spp. (lupines), *Danthonia* spp. (oatgrass), and *Festuca idahoensis* (Idaho fescue) occur commonly. However, the majority of southwestern species do not occur north of the Whaleback-Porcupine Hills area. Central Parkland species conspicuously absent here include *Corylus cornuta* (beaked hazel), *Viburnum opulus* (high-bush cranberry), *Aralia nudicaulis* (sarsaparilla), *Cornus canadensis* (bunchberry), and *Maianthemum canadense* (wild lily-of-the-valley).

The grassland of the Foothills Parkland Subregion is the same as in the Foothills Fescue Subregion, a *Festuca-Danthonia* community with a large diversity of forb and grass species. There are also little-known communities on outwash terraces of major streams that are dominated by *Schizachyrium scoparium* (little bluestem).

Populus tremuloides (aspen) is generally dominant in the upland forests with *Populus balsamifera* (balsam poplar) occurring on moister sites. Common understory species include *Symphoricarpos albus* (snowberry), *Amelanchier alnifolia* (saskatoon), *Spiraea betulifolia* (white meadowsweet), *Lathyrus ochroleucus* (cream-coloured peavine), *Fragaria virginiana (strawberry), Aster subspicatus* (leafy aster), *Osmorhiza occidentalis* (western meadow rue), *Viola canadensis* (Canada violet), *Smilacina stellata* (star-flowered Solomon's seal), *Heracleum lanatum* (cow parsnip), *Angelica dawsonii* (yellow angelica), and *Geranium richardsonii* (white geranium). A distinctive characteristic of these woods in the southwestern part of the subregion is large amounts of *Erythronium grandiflorum* (glacier lily) which bloom in early to mid-May.

Willow groveland dominated by *Salix bebbiana* (Bebb's willow) occurs extensively on fine-textured glaciolacustrine material and on imperfectly to poorly-drained morainal sites. This distinctive community occurs mainly in the northern part of the subregion. Understory species include *Perideridia gairdneri* (squaw root), *Anemone canadensis* (Canada anemone), *Delphinium glaucum* (tall larkspur) and *Geranium richardsonii* (white geranium).
Populus angustifolia (narrow-leaved cottonwood) forests occur on shifting fluvial terrace deposits in the southern part of the subregion. These are most extensive in the Foothills Fescue Subregion and are described more there.

Wildlife
Many species that occur in the Central Parkland Subregion are missing here but other species give this Subregion a distinctive character. Rocky Mountain species in upland forests and shrublands include dusky flycatcher, MacGillivray's warbler, lazuli bunting and white-crowned sparrow. In the far south, black-headed grosbeaks and blue grouse are typical of aspen forests.

3.2.3 Peace River Parkland Subregion

Geology and Landforms
The Peace River Parkland is characterized by broad, gently rolling plains with scattered upland and deeply-incised, steep-sided river valleys. Mass wasting is common along stream valleys and widens many valleys considerably.

The main part of the Peace River Parkland is in the Grande Prairie and Peace River areas but smaller areas occur further north as far as Fort Vermilion. Most of the extensive grasslands of this subregion have been cultivated and only small, scattered remnants are still in native cover.

Cretaceous shales, siltstones and sandstones outcrop along major rivers. However, because of extensive slumping, outcrops are not common since most of the valleys are covered with colluvial, slumped materials. Surficial deposits are predominantly glaciolacustrine silts and clays.

Climate
The mean annual precipitation of the Peace River Parkland is 350-440 mm. The mean May - September temperature is 13°C and the frost-free period averages 95 days. The climate of this subregion has shorter, cooler summer and longer, colder winters than the other parkland subregions. It also has higher precipitation, less wind and lower evaporation

Soils
The soils of the grasslands are mostly Solonetzic while those of the forested portion are mostly Luvisolics. The Solonetzic soils are an important factor in maintaining the grasslands here with fire and, possibly, climate playing a secondary role.

Vegetation
The upland forests of the Peace River Parkland occur mostly on till deposits and are virtually indistinguishable from those of the surrounding Mixedwood Boreal Forest. They are dominated by *Populus tremuloides* (aspen) and *Picea glauca* (white spruce) with lesser amounts of *Populus balsamifera* (balsam poplar) especially on wetter sites. The grasslands, on Solonetzic soils, are dominated by *Carex* spp. (sedges), *Danthonia californica* (intermediate oat grass), *Stipa curtiseta* (western porcupine grass), *Agropyron trachycaulum* (bearded wheatgrass), *Poa interior* (inland bluegrass), *Geum triflorum* (old man's whiskers), and *Solidago missouriensis* (low goldenrod).
Grasslands on steep, south-facing slopes are dominated by *Stipa curtiseta* (western porcupine grass), *Carex* spp.

(sedges), and *Artemisia frigida* (pasture sage). Other common species include *Stipa columbiana* (columbia needle grass), *Koeleria macrantha* (June grass), *Stipa viridula* (green needle grass), *Comandra umbellata* (pale comandra) and *Solidago spathulata* (mountain goldenrod).

More northerly grasslands occur on both fluvial and glaciolacustrine sites and are best characterized as an *Agropyron-Carex* (wheatgrass-sedge) type. These grasslands are dotted with willow groves and dense thickets of *Symphoricarpos occidentalis* (western snowberry) and *Rosa woodsii* (woods rose).

The grasslands of the Peace River Parkland are most closely related to those of the Northern Fescue Subregion. The absence of *Festuca scabrella* (rough fescue) is perhaps not surprising since it is often absent from Solonetzic soils in the Central Parkland and Northern Fescue subregions.

These isolated grasslands are also notable for their disjunct occurrence and the presence of species which have a more southerly or westerly distribution. These include *Opuntia fragilis* (brittle prickly pear cactus), *Stipa richardsonii* (Richardson's needle grass), *Stipa* columbiana (columbia needle grass), *Cirsium drummondii* (short-stemmed thistle), and *Senecio cymbalarioides* (groundsel).

Wildlife
Wildlife of the Peace River Parkland Subregion is similar to that of the adjacent boreal forest mixedwood subregions. Few animals of Central Parkland grassland habitats are present. Lakes and ponds of the Peace River Parkland constitute a major nesting area for the rare trumpeter swan. Three species of fish barely range into Alberta along the upper Peace River: redside shiner, northern squawfish and longscale sucker.

3.3 Foothills Natural Region

The Foothills Natural Region is transitional between the Rocky Mountains Natural Region and the Boreal Forest Natural Region. It consists of two subregions, the Lower Foothills and the Upper Foothills. It occurs from about Turner Valley in the south, north along the eastern edge of the Rocky Mountains in a gradually widening belt, and also includes several outlying hill masses such as Swan Hills, Pelican Mountain, and the Naylor Hills.

3.3.1 Lower Foothills Subregion

Geology and Landforms
The Lower Foothills Subregion generally occurs on rolling topography created by the deformed bedrock along edge of the Rocky Mountains. Lower elevations range from about 1250 m in the south, to about 700 m near Lesser Slave Lake, 500 m west of Manning, and to about 350 m at the northern end near Rainbow Lake. Upper elevational limits range from about 1450 m in the south to 1000 m in the north. The subregion also includes several flat-topped erosional remnants with flat-lying bedrock that are partially capped with Tertiary gravels, such as Swan Hills, Pelican Mountain, and Clear Hills.

Surficial materials are commonly a morainal veneer or blanket over bedrock. Extensive organic deposits occur in valleys and wet depressions, especially in eastern portions. Along the mountains, bedrock outcrops of marine shales and non-marine sandstones occur often in valleys. Fluvial and glaciofluvial deposits occur along major stream valleys.

Climate
The climatic regime is continental. Mean annual precipitation ranges from 285 mm to 756 mm with an average of about 465 mm, about two-thirds of which falls in May - September. From east to west and from south to north, there are increases in precipitation. The mean May - September temperature is 11°-13°C. With cool summer temperatures and much of the precipitation coming during the growing season, evapotranspiration deficits are generally near zero during the growing season. Although this subregion is somewhat cooler in summer than the adjacent, lower elevation Boreal Forest subregions, it is warmer in winter because it is often not influenced by cold Arctic air masses.

Soils
Soils of upland forests are predominantly Luvisolics and Brunisolics with Gleyed Luvisols and Gleysolics in more poorly drained sites. Organic soils are common in depressional sites, and Regosolics occur along stream valleys and on steeper slopes.

Vegetation
The forests reflect the transitional nature of this subregion in which mixed forests of *Picea glauca* (white spruce), *Picea mariana* (black spruce), *Pinus contorta* (lodgepole pine), *Abies balsamea* (balsam fir), *Populus tremuloides* (aspen), *Betula papyrifera* (paper birch), and *Populus balsamifera* (balsam poplar) occur. Lodgepole pine communities are perhaps the best indication of the lower boundary of this subregion with the adjacent Boreal Forest mixedwood forests. The upper boundary to the Upper Foothills Subregion is marked by the absence of mixed deciduous-coniferous forests (absence of aspen, balsam poplar and birch) and the occurrence of a nearly pure coniferous forest cover.

At lower elevations and along the eastern edge of the subregion, introgressive hybridization between lodgepole pine, a cordilleran species, and jack pine (*Pinus banksiana*), a boreal species, occurs.

Lodgepole pine forests occupy extensive portions of the upland in this subregion, especially following fire. Understory species on drier sites include *Shepherdia canadensis* (buffaloberry), *Spiraea betulifolia* (white meadowsweet), *Juniperus* spp. (junipers), *Arctostaphylos uva-ursi* (bearberry), and *Vaccinium myrtilloides* (low bilberry). On more mesic sites, white spruce and aspen are more frequent in the tree layer and the understory contains a large number of species including *Rosa acicularis* (prickly rose), *Ledum groenlandicum* (Labrador tea), *Cornus canadensis* (bunchberry), *Linnaea borealis* (twin flower), *Epilobium angustifolium* (fireweed), *Vaccinium vitis-idaea* (bog cranberry), and the feathermosses (*Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis*). Successionally, white spruce and, in the north, black spruce, likely will eventually replace lodgepole pine and aspen in these communities in the absence of fire.

Black spruce forests occur on moist upland sites in the north but the species essentially does not occur south of the Red Deer River, although one small, disjunct stand is known near Bragg Creek. Black spruce also occurs on wet Organic soils (muskegs). Typical understory species include *Ledum groenlandicum* (Labrador tea), *Betula* spp. (dwarf birch), *Lonicera involucrata* (bracted honeysuckle), *Equisetum* spp. (horsetails), *Mitella nuda* (bishop's cap), *Linnaea borealis* (twinflower), *Sphagnum* spp. (peat mosses), and the brown mosses (*Aulacomnium palustre, Tomenthypnum nitens*).

Fens, both patterned and unpatterned, are common in much of this subregion. These communities typically contain scattered trees of black spruce and tamarack (*Larix laricina*) with an understory of *Betula* spp. (dwarf birch), *Ledum groenlandicum* (Labrador tea), *Salix* spp. (willow), *Carex* spp. (sedges), *Menyanthes trifoliata* (bog bean), *Deschampsia caespitosa* (tufted hairgrass), and both peat and brown mosses (*Sphagnum* spp., *Tomenthypnum nitens, Aulacomnium palustre*).

Wildlife
Many of the animal species of the Lower Foothills Subregion that inhabit coniferous forests are wide-ranging species that are common to spruce and pine forests of the Boreal Forest, Foothills, and Rocky Mountain Natural Regions. However, for those species that have Rocky Mountain and Boreal Forest subspecies, the Boreal Forest subspecies is characteristic of the Lower Foothills. Species of coniferous forests include boreal chickadee, spruce grouse, ruby-crowned kinglet, white-winged crossbill, and red squirrel.

Areas with deciduous forests have diverse animal communities including ruffed grouse, warbling vireo, black-capped chickadee and Tennessee warbler. Along the boundary with the Central Mixedwood Subregion, species more typical of the boreal forest occur including moose, yellow-bellied sapsucker (northern race), rose-breasted grosbeak and purple finch.

3.3.2 Upper Foothills Subregion

Geology and Landforms
The Upper Foothills Subregion occurs on strongly rolling topography along the eastern edge of the Rocky Mountains from about the Bow River north to the Grande Cache area, with disjunct occurrences in the Swan Hills and Clear Hills. The subregion is generally between the Lower Foothills and Subalpine subregions with an upper elevational limit of about 1500 m in the south to 1000 m in the north. Bedrock outcrops of marine shales and non-marine sandstones are frequent. Morainal deposits are common over bedrock throughout much of the area, although colluvium and residuum occur on steeper terrain.

Climate
This subregion has the highest summer precipitation in Alberta at about 340 mm and has a mean annual precipitation of about 540 mm. July is the wettest month and a moisture surplus probably occurs during much of the growing season. The mean May - September temperature is about 10° - 12°C. The winters are colder than the Lower Foothills Subregion but the Upper Foothills Subregion generally is similarly little affected by cold Arctic air masses.

Soils
Soils of upland sites are typically Luvisolics and Brunisolics with Gleysolics and Organics in wet sites.

Vegetation
Upland forests of the Upper Foothills Subregion are nearly all coniferous and dominated by *Picea glauca* (white spruce), *Picea mariana* (black spruce), *Pinus contorta* (lodgepole pine), and, occasionally, *Abies lasiocarpa* (subalpine fir). Some introgressive hybridization between white spruce and Engelmann spruce (*Picea engelmannii*) and between subalpine fir and balsam fir (*Abies balsamea*) occurs in portions of the subregion.

Lodgepole pine forests occupy extensive portions of the subregion on upland sites. Understory species typically include *Menziesia ferruginea* (false azalea), *Shepherdia canadensis* (buffaloberry), *Rosa acicularis* (prickly rose), *Ledum groenlandicum* (Labrador tea), *Cornus canadensis* (bunchberry), *Linnaea borealis* (twin flower), *Epilobium angustifolium* (fireweed), *Vaccinium vitis-idaea* (bog cranberry), and the feathermosses (*Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis*). Successionally, white spruce and black spruce likely will eventually replace lodgepole pine in these communities in the absence of fire.

The understory of upland spruce forests in this subregion is very similar to that of the lodgepole pine forests with older stands on mesic sites often having a well developed moss layer dominated by feathermosses (*Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis*).

Black spruce dominates on wet sites with Organic and Gleysolic soils. Typical understory species include *Ledum groenlandicum* (Labrador tea), *Betula* spp. (dwarf birch), *Lonicera involucrata* (bracted honeysuckle), *Equisetum* spp. (horsetails), *Mitella nuda* (bishop's cap), *Linnaea borealis* (twinflower), *Sphagnum* spp. (peat mosses), and brown mosses (*Aulacomnium palustre, Tomenthypnum nitens*).

Wildlife
Animals of the Upper Foothills Subregion are similar to those of coniferous forests of the Lower Foothills and Subalpine Subregions. These include pine siskin, yellow-rumped warbler, ruby-crowned kinglet, white-crowned sparrow and varied thrush. Elk and both black and grizzly bear are also characteristic. Species diversity is lower here, generally, than in the Lower Foothills Subregion because of a lower vegetational diversity, including few deciduous forest stands.

3.4 Rocky Mountain Natural Region

The Rocky Mountain Natural Region is part of a major uplift that trends along the western part of Alberta forming the Continental Divide. It is separated from the Foothills Natural Region primarily by structural geology, age and lithology. The Rocky Mountain Natural Region is underlain primarily by upthrust and folded carbonate and quartzitic bedrock whereas the Foothills Natural Region is mostly deformed sandstone and shale. Exceptions include areas of the Montane Subregion in the 'geological' Foothills of the Porcupine and Cypress Hills, and occurrences of the Subalpine and Alpine subregions on folded bedrock of the 'geological' Foothills Belt in the Kakwa area.

This Region is the most rugged topographically in Alberta and ranges from about 10 km wide in the Waterton Lakes National Park area to more than 100 km wide in the central portion. Elevations rise from east to west, from major river valleys at 1000 to 1500 m to 3700 m along the Continental Divide.

The two major mountain ranges, the easterly Front Ranges and the westerly Main Ranges, are composed mostly of thrust-faulted sediments. Major valleys trend southeast-northwest through the mountains and are occupied by large rivers. Many of Alberta's largest rivers originate here with drainage into the Saskatchewan and Mackenzie river systems. The highest mountains occur in the central part of the Region with the lower mountains in the far north and far south.

Three natural subregions have been recognized, Montane, Subalpine and Alpine, which mainly reflect changes in environmental conditions due to changes in altitude.

3.4.1 Montane Subregion

Geology and Landforms
Much of the southerly portion of the Montane Subregion occurs on east-west trending ridges that extend out from the Foothills Belt from the U.S. border to the Porcupine Hills. The Porcupine Hills are underlain by relatively flat-lying sedimentary rocks. To the north, the Montane Subregion occurs mostly along major river valleys. Along the Bow River, it extends from the lower reaches of the Ghost River to about Castle Junction and, along the North Saskatchewan River from Kootenay Plains to Saskatchewan Crossing. The most northerly outlier is along the Athabasca River and adjacent valleys from Yellowhead Pass to Brule Lake. A small, disjunct area is the Ya-Ha-Tinda along the Red Deer River west of Sundre. Portions of the Cypress Hills are also included here.

Sandstone outcrops are typical of the main, southerly portion. The Cypress Hills are capped by Tertiary gravels and were unglaciated during the last glaciation. The landforms of the major valleys are primarily fluvial and glaciofluvial terraces and fans with smaller areas of glaciolacustrine, aeolian and morainal deposits.
Elevations range from 1000-1350 m in Jasper National Park, to 1350-1600 m in Banff National Park, to more than 1600 along the Eastern Slopes south of Calgary.

Climate
Chinooks are characteristic of the Montane Subregion and it is intermittently snow-free in the winter. The mean temperature for May - September is about 12°C with a mean July temperature of 15°C and a mean January temperature of -8°C. There are about 70 frost-free days per year. Average annual precipitation is about 600 mm with a range of 300 - 1280 mm. Precipitation is lower in the northerly portion of the Montane.

Soils
Soils vary greatly with the complex topographic and climatic conditions in this Subregion and a wide range of soils is typical. Soils under grasslands are mostly Chernozemics, Brunisolics and Regosolics. Forest soils include Brunisolics and Luvisolics.

Vegetation
The Montane landscape is characterized by a pattern of open forests and grasslands. Characteristics tree species include *Pseudotsuga menziesii* (Douglas fir), *Pinus flexilis* (limber pine) and *Picea glauca* (white spruce). Douglas fir forests occur on moderate to steep slopes on colluvial and morainal materials with Brunisolic and Regosolic soils.

On exposed ridges in the eastern part of the Montane, Douglas fir occurs mainly on north and east aspects. Further north in the mountain valleys, it occurs mostly on southerly and westerly aspects. Ridgetop, open forests dominated by Douglas fir and limber pine are among the driest forest communities and are species-rich due to the great habitat diversity.

Closed Douglas fir forests typically have understories containing *Calamagrostis rubescens* (pine grass), *Elymus innovatus* (hairy wild rye), *Carex concinnoides* (northwestern sedge), *Arctostaphylos uva-ursi* (bearberry), *Juniperus* spp. (junipers), and *Symphoricarpos albus* (snowberry). Understory species of importance in the Waterton Lakes National Park area include *Berberis repens* (Oregon grape), *Physocarpus malvaceus* (ninebark), *Acer glabrum* (Rocky Mountain maple), *Clematis occidentalis* (purple clematis), and *Agropyron spicatum* (bluebunch wheat grass).

Limber pine forests are generally open and occur on the most exposed rock outcrops and eroding morainal or colluvial slopes. Common understory species include *Arctostaphylos uva-ursi* (bearberry), *Juniperus* spp. (junipers), *Agropyron spicatum* (bluebunch wheat grass), *Festuca idahoensis* (Idaho fescue), *Galium boreale* (northern bedstraw), *Cerastium arvense* (mouse-ear chickweed), *Penstemon eriantherus* (crested beard-tongue) and *Phacelia* spp. (scorpion-weed).

Grasslands are typically dominated by *Agropyron spicatum* (bluebunch wheatgrass), *Festuca* spp. (fescue grasses) and *Danthonia* spp. (oatgrasses) with a large diversity of forbs. Lodgepole pine forests occur on upland sites and are similar to dry forests of the adjacent Subalpine Subregion. *Shepherdia canadensis* (buffaloberry), *Calamagrostis rubescens* (pine grass), and *Elymus innovatus* (hairy wild rye) are important understory species.

White spruce forests occur on more mesic sites especially along streams on fluvial terraces. Aspen forests occur characteristically on fluvial fans and terraces often with Regosolic and Brunisolic soils.
The forests of the Cypress Hills lack Douglas fir and limber pine. However, the occurrence of lodgepole pine, white spruce, aspen and balsam poplar, as well as many understory species with southern and southwestern affinities, indicate the relationship with the Montane Subregion along the Rocky Mountains.

Wildlife
Douglas fir - limber pine habitats are typically inhabited by blue grouse, mountain chickadee, Hammond's flycatcher, Clark's nutcracker, mule deer, elk and Columbian ground squirrel. These habitats are also important ungulate winter range. Denser Douglas fir and lodgepole pine forests also contain yellow-rumped warbler (Audubon's subspecies), dark-eyed junco (Oregon subspecies), chipping sparrow, red crossbill, pine siskin and red squirrel. Aspen forests typically contain MacGillivray's warbler, warbling vireo and lazuli bunting.

Wetlands, streams and lakes are very productive for wildlife with Barrow's goldeneye, common snipe, red-winged blackbird, common yellowthroat, beaver, muskrat, and western toad. Spotted frog and long-toed salamander are two species of wet areas that are restricted to the Rocky Mountain Natural Region in Alberta.

The Cypress Hills have a distinctive but depauperate fauna due to their isolated position and the nature of post-glacial colonization. Several species typical of the Montane Subregion, such as mountain chickadee and blue grouse, do not occur in the Cypress Hills. However, the Mearn's subspecies of the dark-eyed junco occurs in Canada only in the Cypress Hills.

3.4.2 Subalpine Subregion

Geology and Landforms
The Subalpine Subregion occupies a band between the Montane and Alpine Subregions in the south and between the Upper Foothills and Alpine Subregions in the north. The boundary between the Subalpine and the Upper Foothills is

based partly on the changes from Foothills bedrock to Rocky Mountain strata, although portions of the Foothills Geological Belt are included in the Subalpine Subregion in the Kakwa area.

The upper limit of the Subalpine Subregion ranges from about 2300 m in southern Alberta to 2000 m in northern Alberta. Lower elevational limits are around 1600 m in the south and 1350 m in the north.
Morainal materials occupy much of the Subalpine Subregion with colluvial and residual bedrock materials frequent at higher elevations. Fluvial and glaciofluvial deposits are common along stream valleys, with lesser amounts of glaciolacustrine and aeolian materials.

Climate
The mean annual temperature ranges from -1°C to 3°C with a mean July temperature of 15°C in the south and 9°C in the north. Below freezing temperatures occur in all months and the frost-free period is likely less than 30 days. Total annual precipitation ranges from 460 mm in the drier Front Ranges to more than 1400 mm in parts of the south. Winter precipitation is higher in this subregion than any other in Alberta with often more than 200 cm of snowfall.

Soils
Soils vary widely reflecting the great diversity in parent materials and ecological conditions. Brunisolics and Luvisolics are most common and occur under a wide variety of conditions. Regosolics commonly occur on colluvial slopes and on active fluvial landforms. Podzolics are largely confined to upper elevation, moist sites under spruce-fir forests. Cryosolics occur in Upper Subalpine sites in the Front Ranges from central Banff National Park to at least as far north as Willmore Wilderness Park. Solifluction is a common process on these sites. Gleysolics and Organics occur on wet sites on a variety of materials.

Vegetation
The Subalpine is often divided into two portions - a Lower Subalpine characterized by closed forests of lodgepole pine, Engelmann spruce and subalpine fir, and an Upper Subalpine with spruce-fir closed forests and open forests near treeline. The spruce at lower elevations is often an introgressive hybrid between white spruce and Engelmann spruce. At higher elevations, pure Engelmann spruce is characteristic.

At lower elevations in the Subalpine Subregion, lodgepole pine forests cover extensive areas following fire. Common understory species include *Shepherdia canadensis* (buffaloberry), *Elymus innovatus* (hairy wild rye), *Aster conspicuus* (showy aster), *Arctostaphylos uva-ursi* (bearberry), *Juniperus* spp. (junipers), *Arnica cordifolia* (heart-leaved arnica), *Linnaea borealis* (twinflower), *Orthilia secunda* (one-sided wintergreen) and *Cornus canadensis* (bunchberry). At higher elevations, *Menziesia ferruginea* (false azalea) and *Vaccinium scoparium* (grouseberry) are important. In the south, *Rubus parviflorus* (thimbleberry), *Symphoricarpos occidentalis* (western snowberry), *Spiraea betulifolia* (white spiraea) and *Acer glabrum* (Rocky Mountain maple) are also important.

Engelmann spruce-subalpine fir forests typically occur on higher, moister sites which have not been as subject to fire as the lodgepole pine forests. These forests occupy a wide variety of landforms and environmental conditions. Typical understory species include *Menziesia ferruginea* (false azalea), *Vaccinium membranaceum* (huckleberry), *Rhododendron albiflorum* (white-flowered rhododendron), *Vaccinium scoparium* (grouseberry), *Moneses uniflora* (one-flowered wintergreen), *Cornus canadensis* (bunchberry) and *Orthilia secunda* (one-sided wintergreen). Older, mesic forests have a thick carpet of mosses and lichens including *Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis, Dicranum scoparium* and *Peltigera aphthosa.*

The understory of the forests of the Waterton Lakes National Park area contains a number of species that do not occur further north. These include *Xerophyllum tenax* (beargrass), *Rubus parviflorus* (thimbleberry), *Luzula piperi* (Piper's wood rush), *Tiarella trifoliata* (foam flower) and *Pachystima myrsinites* (mountain lover).

Open forests in the Upper Subalpine are transitional to the treeless Alpine Subregion above. Dominant trees include Engelmann spruce, subalpine fir, whitebark pine (*Pinus albicaulis*) and, south of Bow Pass, subalpine larch (*Larix lyallii*). Forests with herbaceous understories are dominated by *Senecio triangularis* (arrowleaf groundsel), *Erigeron peregrinus* (subalpine fleabane), *Valeriana sitchensis* (mountain valerian), *Anemone occidentalis* (western anemone) and *Vahlodea purpurea* (mountain hairgrass). Other forests contains dwarf shrubs which also occur in the Alpine Subregion including *Phyllodoce empetriformis* (red heather), *Phyllodoce glanduliflora* (yellow heather), *Cassiope mertensiana* (white mountain heather), *Vaccinium scoparium* (grouseberry), and *Salix vestita* (rock willow).

High elevation grasslands occur in the Subalpine, mostly on steep, southerly and westerly aspects in the Front Ranges. Dominant species include *Elymus innovatus* (hairy wild rye), *Koeleria cristata* (June grass), and *Arctostaphylos uva-ursi* (bearberry). Snow avalanches also create a diverse mix of shrubby and herbaceous communities.

Wildlife
The occurrence of animal species in the Subalpine Subregion generally overlaps with the Subregions above and below. Some species are common to both the Montane and Subalpine Subregions; others occur in both the Subalpine and Alpine Subregions. Species of the coniferous forests are widespread throughout the Foothills and Boreal Forest Natural Region including spruce grouse, gray jay, golden and ruby-crowned kinglets, yellow-rumped warblers, pine siskin, boreal chickadee, marten, snowshoe hare, black bear, deer mouse, red-backed vole and red squirrel.

Several Subalpine forest birds are restricted to the Rocky Mountain Natural Regions including Steller's jay, varied thrush and Townsend's warbler. These species, along with winter wren, are most common in the Main Ranges along the Continental Divide and in the extreme southwest.

A few species are confined to the northern part of the Subregion, such as willow ptarmigan, mountain caribou and golden-crowned sparrow.

Typical of higher elevations near timberline are hermit thrush, white-crowned sparrow, Brewer's sparrow, and golden-crowned sparrow. Rock fields are used by golden-mantled ground squirrel, yellow pine chipmunk, least chipmunk, pika and hoary marmot. American dippers and harlequin ducks occur along fast-flowing streams.

3.4.3 Alpine Subregion

Geology and Landforms
The Alpine Subregion includes all areas above treeline including vegetated areas, rockland, snowfield and glaciers.

Materials are generally residual bedrock and colluvium often on steep slopes. Extensive areas of unvegetated bedrock occur. Rock glaciers occur from Kananaskis Country north to Jasper National Park. Neoglacial landforms are especially prevalent in the Main Ranges of Banff and Jasper national parks.

Climate
Climatic data for the Alpine Subregion are spotty both geographically and in time. Few records are available for the winter period. However, this clearly is the coldest subregion in Alberta with mean May - September temperatures of about 6°C and essentially no frost-free period. Winter temperatures are colder than the Subalpine Subregion. Mean annual precipitation ranges from 420-850 mm and is likely higher for some areas. Greater wind speeds are a factor both in redistributing snow and especially in increasing cooling and evapotranspiration rates.

Soils
Much of the Alpine Subregion has no soil, the amount of weathered material being too thin to qualify as a soil. Soils in general are weakly-developed Regosolics and Brunisolics. A few Podzolics have develop under heath communities, especially where a thick layer of aeolian material, including volcanic ash, has accumulated. Gleysolics occur in wet sites. Cryosolics occur but their extent is poorly known.

Vegetation
Alpine vegetation typically forms a complex, fine-scale mosaic in which microclimatic variations are reflected by marked changes in dominant species. Significant environmental factors include aspect, wind exposure, time of snow melt, soil moisture and snow depth.

Deep, late-melting snowbeds are occupied by *Carex nigricans* (black alpine sedge) communities. Moderate snowbed communities typically contain dwarf shrub heath tundra which is dominated by *Phyllodoce* spp. (heathers), *Cassiope* spp. (mountain heathers), and *Vaccinium scoparium* (grouseberry). Shallow snow areas on ridgetops and other exposed sites typically contain communities dominated by *Dryas octopetala* (white mountain avens), *Salix nivalis* (snow willow) and *Silene acaulis* (moss campion), or *Kobresia myosuroides* (kobresia). Diverse, colourful herb meadows occur in moist sites below melting snow banks or along streams. Highest elevation communities are composed mainly of lichens on rocks and shallow soil.

Some floristic differences are apparent south of Crowsnest Pass. *Cassiope* spp. (mountain heathers) are absent and *Phyllodoce* spp. (heathers) are more restricted than further north. *Xerophyllum tenax* (bear grass) meadows occur in some low elevation Alpine areas and other vegetation communities are apparently confined to this part of the province.

Wildlife
Many species range regularly in both the Subalpine and Alpine Subregions, including Columbian ground squirrel, pika, hoary marmot, grizzly bear, mountain goat, and bighorn sheep. White-tailed ptarmigan, gray-crowned rosy finch, horned lark and water pipit are restricted to the Alpine Subregion during the nesting season.

3.5 Boreal Forest Natural Region

The Boreal Forest Natural Region is the largest in Alberta. It consists of broad lowland plains and discontinuous but locally extensive hill systems. The bedrock is buried deeply beneath glacial deposits and outcrops occur only rarely along major stream valleys. Major surficial features are moraines in the uplands, and glaciofluvial and glaciolacustrine deposits in the lowlands. Fluvial deposits, including the Peace-Athabasca Delta, occur along major rivers. The land generally slopes to the north and east but the most prominent highlands are located in the northern part of the Region. The Region drains primarily into the Mackenzie River system although a substantial portion of the southern subregions is part of the Saskatchewan River system.

The presence of extensive wetlands is a major characteristic of the Boreal Forest Natural Region. Large wetlands occupy large areas of the lowlands. Bogs, fens, and swamps are abundant and marshes are locally prevalent.
The Boreal Forest Natural Region is very diverse topographically, climatically and biologically. Many of the changes are gradual and subtle which makes division into subregions often difficult and seemingly arbitrary. Lack of adequate information about much of this vast area further compounds the problems. However, the Region has been divided into six subregions (Dry Mixedwood, Central Mixedwood, Wetland Mixedwood, Boreal Highlands, Peace River Lowlands, Subarctic) based primarily on vegetational, geological and landform characteristics.

3.5.1 Dry Mixedwood Subregion

Geology and Landforms
The Dry Mixedwood Subregion is characterized by low relief and level to undulating terrain. Surficial materials are mostly till as ground moraine and hummocky moraine landforms with some areas of aeolian dunes and sandy outwash plain. The Subregion includes two main areas: the southern edge of the Boreal Forest Natural Region from Cold Lake west to about Barrhead and south along the western edge of the Central Parkland Subregion to about Gull Lake and a broad land from Lesser Slave Lake to Grande Prairie then north along the Peace River to Fort Vermilion. The Cooking Lake moraine east of Edmonton is a disjunct portion of this Subregion.

Drainage is to both the Saskatchewan and Mackenzie river systems via numerous rivers and small streams.

Climate
The climate of this Subregion is subhumid, continental with short, cool summers and long, cold winters. The mean May - September temperature is about 13°C and the growing period is about 90 days. Annual precipitation averages about 350 mm with June and July the wettest months. Winters are relatively dry with about 60 mm of precipitation. Overall, the climate is somewhat drier and warmer than the Central Mixedwood Subregion with somewhat higher moisture deficits.

Soils
Soils are typically Gray Luvisols in well-drained, upland till sites and Eutric Brunisols in coarse-textured sandy uplands. Organics and Gleysolics occur on wet depressional sites.

Vegetation
The vegetation of the Dry Mixedwood Subregion is transitional between the Central Parkland and Central Mixedwood Subregions and there are community types common to all three. The differences are largely in the proportion of various vegetation types and other landscape features. *Populus tremuloides* (aspen) is an important species in all three Subregions, occurring in both pure and mixed stands. *Populus balsamifera* (balsam poplar) fre-

quently occurs with aspen especially on moister sites in depressions and along streams.

Successionally, *Picea glauca* (white spruce) and, eventually in some areas, *Abies balsamea* (balsam fir) can be expected to increase or replace aspen and balsam poplar as stand dominants. However, frequent fire seldom permits this to occur and pure deciduous stands are common in the southern part of the Dry Mixedwood Subregion. Coniferous species are more common further north in the Dry Mixedwood Subregion with mixed stands of aspen and white spruce being widespread. Older stands in protected sites, such as islands, may have significant amounts of balsam fir.

Upland aspen forests contain a diverse understory that may include *Viburnum edule* (low-bush cranberry), *Corylus cornuta* (beaked hazel), *Rosa acicularis* (prickly rose), *Cornus stolonifera* (red-osier dogwood), *Calamagrostis canadensis* (marsh reed grass), *Aralia nudicaulis* (sarsaparilla), *Rubus pubescens* (dewberry), *Lathyrus ochroleucus* (cream-coloured peavine), *Pyrola asarifolia* (pink wintergreen) and *Linnaea borealis* (twinflower). Both balsam poplar and *Betula papyrifera* (paper birch) may occur in these forests as well.

Coniferous, spruce or spruce-fir forests are not common but generally have a less diverse understory with greater moss cover especially of the feathermosses (*Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis*).

Mixedwood forests generally contain a mosaic of deciduous and coniferous patches with species typical of each occurring through the stand.

Dry, sandy upland sites are usually occupied by *Pinus banksiana* (jack pine) forests. These may be quite open and have a prominent ground cover of lichens. Other understory species may include *Arctostaphylos uva-ursi* (bearberry), *Vaccinium myrtilloides* (low bilberry), *Vaccinium vitis-idaea* (bog cranberry) and *Rosa acicularis* (prickly rose).

Peatlands are common throughout the Subregion and are extensive in some areas, e.g. south of Athabasca, but are not as prevalent as in other Boreal Forest Subregions. Peatland complexes typically contain both nutrient-poor, acidic bog portions, dominated by *Picea mariana* (black spruce), *Ledum groenlandicum* (Labrador tea), and *Sphagnum* spp. (peatmosses) and more nutrient-rich fens, containing *Larix laricina* (tamarack), *Betula* spp. (dwarf birches), *Carex* spp. (sedges), and brown mosses (*Aulacomnium palustre, Tomenthypnum nitens, Drepanocladus* spp.). Patterned peatlands occur in several areas.

Wildlife
Characteristic species of deciduous forests in the Dry Mixedwood Subregion include least flycatcher, house wren, ovenbird, red-eyed and warbling vireos, Baltimore oriole and rose-breasted grosbeak. Species of mixedwood forests include yellow-bellied sapsucker, Swainson's thrush, solitary vireo, magnolia warbler, white-throated sparrow, pileated woodpecker and northern goshawk.

A few species are restricted to the Cold Lake area and represent an eastern faunal element. These include yellow rail, sedge wren, great-crested flycatcher, chestnut-sided warbler and blackburnian warbler.
Typical mammals include beaver, moose, varying hare, black bear, wolf, lynx and ermine.

3.5.2 Central Mixedwood Subregion

Geology and Landforms
Surficial materials in the Central Mixedwood Subregion are predominantly till as ground moraine and hummocky moraine landforms with some areas of aeolian dunes, sandy outwash plain, and glaciolacustrine plain. The terrain has low relief and a level to undulating surface. The Subregion includes the much of the central and southeastern part of the Boreal Forest Natural Region and is the largest Subregion in Alberta. Highland plateaus and hill masses within the Central Mixedwood Subregion are mostly placed in other Subregions such as the Boreal Highlands although similarities are apparent.

Climate
The climate of the Central Mixedwood Subregion is subhumid, continental with short, cool summers and long, cold winters. The mean May - September temperature is about 12°C and the frost-free period is about 85 days. Annual precipitation averages about 380 mm with June and July the wettest months. Winters are relatively dry. Overall, the climate is somewhat moister and cooler than the Dry Mixedwood Subregion with somewhat lower moisture deficits.

Soils
Soils are similar to those of the Dry Mixedwood Subregion with Gray Luvisols in well-drained, upland till sites and Eutric Brunisols in coarse-textured sandy uplands. Organics and Gleysolics occur on wet depressional sites.

Vegetation
The vegetation of the Central Mixedwood Subregion is similar to that of the Dry Mixedwood Subregion with many community types in common. The differences are largely in the proportion of various vegetation types and other landscape features. *Populus tremuloides* (aspen) is the characteristic forest species occurring in both pure and mixed stands. *Populus balsamifera* (balsam poplar) frequently occurs with aspen especially on moister sites in depressions and along streams.

Betula papyrifera (paper birch) also occurs commonly with aspen. It forms nearly pure stands infrequently, e.g. in the Christina Highland north of Lac La Biche; the reason for this is not clear although it may be related to sandy soils.

Successionally, *Picea glauca* (white spruce) and, eventually, *Abies balsamea* (balsam fir) can be expected to increase or replace aspen and balsam poplar as stand dominants. However, frequent fire seldom permits this to occur and pure deciduous stands are common in the southern part of the Subregion. Further north, coniferous species are more common with mixed stands of aspen and white spruce being widespread. Older stands in protected sites, such as islands, may have significant amounts of balsam fir.

Upland aspen forests contain a diverse understory that may include *Viburnum edule* (low-bush cranberry), *Corylus cornuta* (beaked hazel), *Rosa acicularis* (prickly rose), *Cornus stolonifera* (red-osier dogwood), *Calamagrostis canadensis* (marsh reed grass), *Aralia nudicaulis* (sarsaparilla), *Rubus pubescens* (dewberry), *Lathyrus ochroleucus* (cream-coloured peavine), *Pyrola asarifolia* (pink wintergreen) and *Linnaea borealis* (twinflower). Both balsam poplar and *Betula papyrifera* (paper birch) may occur in these forests as well.

Coniferous-dominated, spruce or spruce-fir forests are not common but generally have a less diverse understory with

greater moss cover especially of the feathermosses (*Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis*).

Mixedwood forests, containing a mosaic of deciduous and coniferous patches with species typical of each are widespread throughout the Subregion and characteristic of upland sites.

Dry, sandy upland sites are typically occupied by *Pinus banksiana* (jack pine) forests. These may be quite open and have a prominent ground cover of lichens. Other understory species may include *Arctostaphylos uva-ursi* (bearberry), *Vaccinium myrtilloides* (low bilberry), *Vaccinium vitis-idaea* (bog cranberry) and *Rosa acicularis* (prickly rose).

Fluvial deposits along major stream valleys have white spruce or white spruce-balsam poplar forests that often contain large trees that have benefitted from the favourable nutrient and moisture regimes of these sites. Gleyed Luvisols and Gleysolics are typical of these sites. Peatlands are common and extensive throughout the Central Mixedwood Subregion. Peatland complexes typically contain both nutrient-poor, acidic bog portions, dominated by *Picea mariana* (black spruce), *Ledum groenlandicum* (Labrador tea), and *Sphagnum* spp. (peatmosses) and more nutrient-rich fens containing *Larix laricina* (tamarack), *Betula* spp. (dwarf birches), *Carex* spp. (sedges), and brown mosses (*Aulacomnium palustre, Tomenthypnum nitens, Drepanocladus* spp.). Patterned peatlands occur commonly in several areas.

Wildlife
The wildlife of the Central Mixedwood Subregion is the most diverse and varied of the Boreal Forest Natural Region. The species of coniferous forests are wide-ranging and include western wood peewee, gray jay, red-breasted nuthatch, golden and ruby-crowned kinglets, yellow-rumped warbler, pine siskin, red and white-winged crossbills, dark-eyed junco, boreal chickadee, and red squirrel. Three warblers, bay-breasted, Cape May and black-throated green, are confined largely to mature conifer dominated mixedwood stands in the central and eastern portions of the Subregion. Balsam fir stands have a particularly diverse assemblage of coniferous forest birds.

Characteristic species of deciduous forests are similar to those in the Dry Mixedwood Subregion and include least flycatcher, house wren, ovenbird, red-eyed and warbling vireos, Baltimore oriole and rose-breasted grosbeak. Species of mixedwood forests include yellow-bellied sapsucker, Swainson's thrush, solitary vireo, magnolia warbler, white-throated sparrow, pileated woodpecker and northern goshawk.

The most species-rich habitats are mixedwoods and shrublands associated with swamps, ponds, streams and lakes. Some species, such as yellow and black-and-white warblers, American redstart, song sparrow, northern water thrush, fox sparrow and Philadelphia vireo are mostly restricted to these sites. Barred owl occasionally occurs in mature mixedwoods along lakeshores and river valleys.

Typical, widespread mammals include beaver, moose, varying hare, black bear, wolf, lynx, Gapper's red-backed vole, cinereous shrew, deer mouse, least chipmunk, moose and ermine. Others, such as fisher, wolverine, river otter, and woodland caribou, are less common and locally distributed.

3.5.3 Wetland Mixedwood Subregion

Geology and Landforms
The topography of the Wetland Mixedwood Subregion is generally subdued and nearly level to gently rolling. Elevations range from about 280 to 450 m. Surficial materials are predominantly glaciolacustrine overlain by extensive organic and till deposits. Limited areas of glaciofluvial and aeolian sandy deposits also occur.

Climate
The climate of this Subregion is characterized by cool, moist summers and long, cold winters. It is generally colder than the Central Mixedwood Subregion but probably more moderate than the Subarctic or Boreal Highlands subregions. The mean May - September temperature is about 11°C and the frost-free period is about 85 days. Average annual precipitation is 400-450 mm with 250-300 mm in the summer. Snow cover lasts an average of 185 days per year, one of the longest in Alberta.

Soils
Organic and Gleysolic soils are widespread in the wet depressional sites that are prevalent in this Subregion. Permafrost occurs in many peatlands in a discontinuous fashion. Upland sites typically have Gray Luvisols on fine or medium-textured materials or Eutric Brunisols on coarse-textured materials.

Vegetation
The vegetation of the Wetlands Mixedwood Subregion appears quite similar to that of the Central Mixedwood Subregion, although little is known about much of it. Generally, the landscape in this Subregion contains a greater proportion of wetlands, both peatlands and willow-sedge complexes on mineral soil, and more upland black spruce forest than the Central Mixedwood. This perhaps reflects the more rigourous, cooler climate with a lower moisture deficit. The differences are subtle and need further examination.

Drier tills and glaciofluvial deposits typically have Brunisolic soils with pine forests, *Pinus contorta* (lodgepole pine) in the west and *Pinus banksiana* (jack pine) in the east. Mesic till sites are limited in area but contain typical aspen-white spruce mixedwood forest with Gray Luvisols similar to those of the Central Mixedwood Subregion but apparently with fewer understory species.

Moist upland sites on tills and glaciolacustrine deposits generally have black spruce or mixed black and white spruce closed forests with a well-developed moss layer dominated by feathermosses (*Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis*).

Mature white spruce-balsam poplar forests, similar to those along the lower Peace and Athabasca rivers, occur along the lower Hay River on fluvial terraces.

Peatlands are common and extensive throughout the Wetland Mixedwood Subregion. Peatland complexes typically contain both nutrient-poor, acidic bog portions, dominated by *Picea mariana* (black spruce), *Ledum groenlandicum* (Labrador tea), and *Sphagnum* spp. (peatmosses) and more nutrient-rich fens containing *Larix laricina* (tamarack), *Betula* spp. (dwarf birches), *Carex* spp. (sedges), and brown mosses (*Aulacomnium palustre, Tomenthypnum nitens, Drepanocladus* spp.). Patterned peatlands occur in several areas. Permafrost frequently occurs in these peatlands as well.

Wildlife
The wildlife of the Wetland Mixedwood Subregion is relatively depauperate both in species and numbers compared with the Central Mixedwood Subregion. The scarcity of deciduous and mixedwood communities is largely responsible for this. The extensive wetlands that characterize this Subregion provide important habitat for nesting and migrating waterfowl including sandhill crane and the rare whooping crane.

3.5.4 Boreal Highlands Subregion

Geology and Landforms
The Boreal Highlands Subregion occurs on the sides and tops of plateaus and hill masses within the Central Mixedwood and Wetland Mixedwood subregions. It includes portions of the Cameron Hills, Caribou Mountains, Buffalohead Hills, Birch Mountains, Thickwood Hills, and the highlands around Graham and Peerless lakes, and south of Ft. McMurray. The topography varies from rolling uplands to steep slopes on the flanks of hill masses and plateaus.

Most of the subregion is covered by glacial till in the form of both ground moraine and hummocky moraine. Aeolian dune fields occupy limited areas.

Climate
Climatic data are scarce for this Subregion but conditions appear somewhat cooler and moister than the Central Mixedwood Subregion. May - September temperatures average 12°C but the winter temperatures are likely colder than the Central Mixedwood. May - September precipitation is about 265 mm which is slightly greater than the Central Mixedwood and is due mostly to more rain in July and August.

Soils
Soils are similar to those of the Central Mixedwood Subregion with Gray Luvisols in well-drained, upland till sites and Brunisolics in coarse-textured sandy uplands. Organics and Gleysolics occur on wet depressional sites.

Vegetation
The vegetation of the Boreal Highlands Subregion is similar to that of the Central Mixedwood Subregion. Mixedwood forests of aspen and white spruce are characteristic but with the somewhat moister conditions, greater amounts of balsam poplar and white spruce are expected. Black spruce may also occur more frequently in upland sites and coniferous forests occupy a larger proportion of the landscape.

Upland white spruce-aspen mixedwood and aspen forests contain a diverse understory that may include *Viburnum edule* (low-bush cranberry), *Rosa acicularis* (prickly rose), *Cornus stolonifera* (red-osier dogwood), *Calamagrostis canadensis* (marsh reed grass), *Aralia nudicaulis* (sarsaparilla), *Rubus pubescens* (dewberry), *Lathyrus ochroleucus* (cream-coloured peavine), *Pyrola asarifolia* (pink wintergreen) and *Linnaea borealis* (twinflower). Both balsam poplar and *Betula papyrifera* (paper birch) may occur in these forests as well.

Coniferous-dominated, spruce or spruce-fir forests generally have a less diverse understory with greater moss cover especially of the feathermosses (*Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis*).

Dry, sandy upland sites are typically occupied by *Pinus banksiana* (jack pine) forests. Typical understory species include *Arctostaphylos uva-ursi* (bearberry), *Vaccinium myrtilloides* (low bilberry), *Vaccinium vitis-idaea* (bog cranberry), *Rosa acicularis* (prickly rose) and reindeer lichens (*Cladina* spp. and *Cetraria nivalis*).

Peatlands are common and extensive throughout the Subregion. Peatland complexes typically contain both nutrient-poor, acidic bog portions, dominated by *Picea mariana* (black spruce), *Ledum groenlandicum* (Labrador tea), and *Sphagnum* spp. (peatmosses) and more nutrient-rich fens containing *Larix laricina* (tamarack), *Betula* spp. (dwarf birches), *Carex* spp. (sedges), and brown mosses (*Aulacomnium palustre, Tomenthypnum nitens, Drepanocladus* spp.). Patterned peatlands occur in some areas and permafrost is frequent.

Wildlife
The animals of the Boreal Highlands Subregion are similar to those of the Central Mixedwood Subregion, although the species diversity is somewhat reduced although not as much as in the Subarctic Subregion. The occurrence of woodland caribou in the Birch and Caribou mountains is noteworthy although this species also uses adjacent Subregions as well.

3.5.5 Peace River Lowlands Subregion

Geology and Landforms
The Peace River Lowlands Subregion consists primarily of fluvial landforms along the lower Peace, Birch and Athabasca rivers including the Peace-Athabasca Delta, one of the largest freshwater deltas in the world. Although the bedrock is seldom exposed, it influences the character of till deposits and groundwater discharge. The bedrock includes Cretaceous marine shales and silty shales, Devonian marine limestones and dolomites, evaporite gypsum and anhydrite, and marine shales and siltstones. Some lacustrine deposits also occur in the Subregion.

Climate
The climate of the Peace River Lowlands Subregion is characterized by a cool summers and long, cold winters. The mean annual temperature is -3.5°C. The mean May - September temperature is about 11°C (range 10-13°C) increasing slightly to the northeast. Total annual precipitation is divided about equally between snow and rain. Total May - September precipitation averages 250 mm (range 150-300 mm), increasing to the southeast.

Soils
Soils on well drained upland sites are mostly Eutric Brunisols and Gray Luvisols. However, the majority of the Subregion is occupied by Cumulic Regosols and Gleysolics on active fluvial landforms or by Organics in wet depressional areas.

Vegetation
White spruce forests containing large trees (16-23 m tall) occur on imperfectly to well drained fluvial terraces along major rivers. These forests have been heavily logged and little remains of this very productive forest currently.

On drier upland sites, forests of *Pinus banksiana* (jack pine), *Alnus crispa* (green alder), *Vaccinium vitis-idaea* (bog cranberry), *Cladina alpestris* (reindeer lichen) and feathermosses occur with Brunisolic soils. Mixedwood forests of aspen, balsam poplar, and white spruce occur on mesic sites with Luvisolic soils.

Non-forested, wet fluvial communities form a very complex mosaic of aquatic, shoreline, meadow, shrub and marsh vegetation. Much of this complexity is driven by periodic

flooding and deposition of fresh fluvial sediments, especially in the Peace-Athabasca Delta area.

Wildlife
The overall diversity of wildlife is lower here than in the Central Mixedwood Subregion although many of the same species occur in both Subregions. However, the Peace-Athabasca Delta supports a rich wildlife population and is a major nesting and moulting ground for ducks, and a key staging and migration area for waterfowl such as tundra swan. Bison also use the large wet sedge meadows. Muskrats are also important in this area.

White pelicans nest along the Slave River and the most northerly populations and hibernacula of common (red-sided) garter snakes also occur in this Subregion.

A very diverse fish assemblage occurs in this Subregion. Lake whitefish, northern pike, goldeneye, emerald shiner, longnose sucker, trout-perch, walleye, ninespine stickleback, flathead chub, burbot, spottail shiner, spoonhead sculpin and longnose dace are common in the river and streams of this Subregion. Round whitefish and short-jawed cisco are local and uncommon, and occur nowhere else in Alberta.

3.5.6 Subarctic Subregion

Geology and Landforms
The Subarctic Subregion occurs on the tops of the Birch Mountains, the Caribou Mountains, and the Cameron Hills. These hill systems are erosional remnants that rise above the surrounding plain as flat-topped hills with escarpments that are dissected by numerous small streams.

Surficial deposits are primarily either till or organic peat. The latter predominates in the Subregion and contains discontinuous permafrost. Palsas and peat plateaus occur in these peatland areas and are landforms characteristic of subarctic conditions. Morainal and organic deposits occur on the plateaus, and morainal blankets occur over rolling residuum on the flanks of the hills.

Climate
The climate of the Subarctic Subregion is continental, cold-temperate with moist, short, cool summers and long, cold winters. The mean May - September temperature is about 10-12°C. While summer temperatures are cooler here than in adjacent low elevation areas, winter temperatures are likely more moderate, especially when cold Arctic air masses affect lower areas and temperatures increase with altitude. Total annual precipitation is likely 400-450 mm with most falling in the summer. The frost-free period is less than 45 days.

Soils
Soils are predominantly Organics and Cryosolics on poorly drained sites. Luvisolics occur on well drained sites while Gleysolics are typical of poorly drained mineral soils.

Vegetation
The most widespread vegetation is an open forest of black spruce/Labrador tea/lichen on Organic Cryosols and Organics. Typical understory species include *Ledum groenlandicum* and *Ledum palustre* (both Labrador tea), *Rubus chamaemorus* (cloudberry), *Vaccinium vitis-idaea* (bog cranberry), *Sphagnum* spp. (peat mosses), and *Cladina* spp. (reindeer lichens). Widespread fires in this type have resulted in large areas of heath shrub/lichen vegetation with scattered, young black spruce.

Black spruce forests on moderately well to imperfectly drained mineral soils include a black spruce/feathermoss type which typically includes *Ledum groenlandicum* (Labrador tea), *Vaccinium vitis-idaea* (bog cranberry), *Empetrum nigrum* (crowberry), *Equisetum sylvaticum* (woodland horsetail), *Cornus canadensis* (bunchberry), and the feathermosses, *Hylocomium splendens* and *Pleurozium schreberi*. A similar forest on well drained sites has less cover of feathermosses and greater amounts of lichens, especially *Cladina mitis* and *Cetraria nivalis*.

Less common on warm, well drained till sites are mixed forests of white spruce-aspen or white spruce-paper birch. Black spruce-lodgepole pine (jack pine in the Birch Mountains) also occur in limited areas of warmer, drier sites.

Fens, both patterned and unpatterned, occur in this Subregion often as part of peatland complexes that contain a variety of peatlands and community types. Organic landforms include palsas and peat plateaus that are related to the occurrence of discontinuous permafrost.

Several subarctic plant species also occur in this Subregion including *Pinguicula villosa* (hairy butterwort), *Boschniakia rossica* (ground cone), *Ledum palustre* (Labrador tea), *Vaccinium uliginosum* (bog bilberry), *Arctagrostis arundinacea* (a grass), and *Pedicularis sudetica* (lousewort).

Wildlife
The Subarctic Subregion is lower in wildlife diversity than other Boreal Forest Subregions because of the harsh environment and limited vegetational diversity, especially the scarcity of deciduous communities. Some Boreal Forest species are either local or absent, while other species more typical of Subarctic habitats further north are present. These latter include red-throated loon, arctic loon, surf scoter, tree sparrow and northern phalarope.

Common species of black spruce forests include gray jay, common raven, yellow-rumped warbler, blackpoll warbler, dark-eyed junco, chipping sparrow, red squirrel, snowshoe hare and black bear. Woodland caribou occur in the Birch and Caribou mountains.

Wetland species include lesser yellowlegs, palm warbler, rusty blackbird, Lincoln's sparrow, and moose. On lakes and ponds, common loon, bald eagle, osprey, spotted sandpiper, swamp sparrow and beaver are common. The largest concentration of nesting bald eagles is around Bistcho Lake in the Cameron Hills and there are nesting colonies of white pelicans in the Birch Mountains.

3.6 Canadian Shield Natural Region

The Canadian Shield extends only peripherally into the far northeast corner of Alberta. The Natural Region contains two quite different Subregions. The Kazan Upland Subregion includes most of the exposed Canadian Shield in Alberta north of Lake Athabasca and is characterized by exposed, glaciated bedrock. The Athabasca Plain Subregion includes part of the north shore of Lake Athabasca and the Canadian Shield south of the Lake Athabasca, and is characteristically glacial outwash deposits shallow over Canadian Shield bedrock.

3.6.1 Athabasca Plain Subregion

Geology and Landforms
The Athabasca Plain Subregion is characterized by generally low relief with elevations of 230-640 m. Fluvial and aeolian deposits predominate in the eastern part, till and glaciofluvial deposits in the west. Most deposits are sandy

and derived from the Athabasca sandstone. Extensive stretches of sandy beach occur along Lake Athabasca, including a sand spit that juts three km into the lake at Sand Point. Distinctive landscape features include large areas of kame and kettle, and active dunes. The kames, at over 60 m high, are among the largest in the world. A small but significant area of crag and tail occurs in the lee of resistant granitoid outcrops which protected the till during glacial movement.

The dune fields are mainly parabolic dunes with minor amounts of fish-hook, transverse and paleodunes. The active dune system is the largest in Alberta. The paleodunes are unique in Alberta. They are aligned opposite to other dunces in the province. Also, linear ridges of similar size are not known from any other place in Alberta. Numerous lakes dot the landscape in this portion of the Subregion. Rivers are small and uncommon. Most streams are slow-moving and of the 'muskeg' type.

Climate
Climatic data are scarce for this Subregion. However, the climate can best be characterized as having a warm, moderately dry summer and long, cold winters. The mean May - September temperature is about 13°C and precipitation for this period averages 300 mm.

Soils
Soils of upland sites are predominantly Brunisolics developed in the sandy, coarse-textured parent materials. Podzolics develop in some moister sites. Organics predominate in wet depressional areas with Cryic Fibrisols perhaps most characteristic. Regosolics occur in areas of current aeolian activity.

Vegetation
Extensive forests dominated by *Pinus banksiana* (jack pine) occur on upland sites with sandy, coarse-textured glaciofluvial, glaciolacustrine, ice-contact stratified drift, and aeolian deposits. *Picea glauca* (white spruce) is codominant with jack pine on some sites. Typical understory species on dry sites include *Arctostaphylos uva-ursi* (bearberry), and *Cladina* spp. (reindeer lichens). On more mesic sites, species such as *Vaccinium myrtilloides* (low bilberry) and feathermosses (*Hylocomium splendens, Pleurozium schreberi*) are common.

Peatlands range from relatively dry bogs dominated by jack pine, *Picea mariana* (black spruce), *Ledum groenlandicum* (Labrador tea), and *Cladina* spp. (reindeer lichens) to wetter peatlands with black spruce, *Larix laricina* (tamarack), Labrador tea, and *Sphagnum* spp. (peatmosses). Shrubby peatlands typically contain Labrador tea, *Kalmia polifolia* (swamp laurel), *Carex aquatilis* (water sedge), *Calamagrostis canadensis* (marsh reed grass), and peatmosses.

Riparian habitats are not extensive but contain mixed forests of aspen, balsam poplar and white spruce that are similar to those of the Central Mixedwood Subregion.

The environment in the immediate vicinity of Lake Athabasca is different than the main upland portion of the Subregion and there are significant differences between the north and south shores. "Park-like" open white spruce forests occur along the shore of Lake Athabasca.

A number of significant (rare, endemic, disjunct) plant species occur in the Subregion including *Elymus mollis* (American dune grass), *Tanacetum huronense* var. *bifarium* (tansy), *Utricularia cornuta* (bladderwort), *Juncus brevicaudatus* (rush) and *Stellaria arenicola* (starwort).

Wildlife
Little is known of the animals of the Athabasca Plain Subregion, however there are similarities to both the Kazan Upland Subregion and, in jack pine forest and peatland habitats, to the adjacent Central Mixedwood Subregion. Sandhill cranes are notable breeding species here. As well, arctic and Caspian terns are subarctic species that have nested in the Subregion.

3.6.2 Kazan Upland Subregion

Geology and Landforms
The distinctive feature of the Kazan Upland Subregion is the extensive outcrops of plutonic (granitoid) Precambrian bedrock. The bedrock plays a direct role in the vegetation pattern because of the extent of the outcrops and its acidic nature. The Canadian Shield in northeastern Alberta is dominated by a complex of crystalline plutonic, igneous and metamorphic rocks that are part of the Churchill Structural Province of the Shield. The composition averages between granite and granodiorite. Granitoids comprise about 65% of the outcrops, with gneisses being about 25% and metasediments about 10%.

The predominant rocks are distributed in three major north-south trending belts - the western granitoids, the eastern granitoids, and the central granitic gneisses. Topographic linear features are related to regional faults and bands of relatively soft metasediments.

The topography is rolling and ranges in altitude from 220 - 400 m. Local relief can be as great as 90 m. The bedrock is covered with patches of outwash or morainal deposits, and there are also eskers and roche moutonee knobs. Glacial outwash sands occur near Cornwall, Colin and Andrew lakes. Glacial erosion produced highly-polished, striated and grooved rock surfaces. Rock-basin lakes are common throughout the Subregion.

Rivers are small and not common. Most are of the slow-moving 'muskeg' type.

Climate
Few climatic data are available for the Kazan Upland. The climate generally is cool and subhumid with warm, dry summers and cold winters. The mean May - September temperature is about 12°C.
Annual precipitation averages 320 mm with the May - September precipitation about 175 mm. July and October are the wettest months. Winds are generally light and from the east.

Soils
Much of the Kazan Upland Subregion has no soil, being either exposed bedrock or where the amount of weathered material is too thin over bedrock to qualify as a soil. Where soils have developed in upland sites, Podzolics and Regosolics are most common. Organics and Cryosolics occur in the peatlands.

Vegetation
The vegetation of the uplands is a mosaic of rock barrens, jack pine open forest on sand plains and rocky hills, and black spruce in wet depressional peatlands. Jack pine forests are most widespread, especially in the northeast, and often contain aspen.

The understory of these forests is quite simple and lichens are often as important as vascular plants.

The forests of rocky sites typically contain jack pine, black spruce, *Betula papyrifera* (paper birch), *Amelanchier alnifolia* (saskatoon), *Arctostaphylos uva-ursi* (bearberry), *Saxifraga tricuspidata* (three-toothed saxifrage), *Artemisia frigida* (pasture sage), and *Cladina rangiferina* (reindeer lichen).

On glaciofluvial, ice-contact stratified drift, and till deposits with Podzolic soils, forests of jack pine, paper birch and black spruce have a better developed understory with *Alnus crispa* (green alder), *Vaccinium vitis-idaea* (bog cranberry), *Arctostaphylos uva-ursi* (bearberry), *Vaccinium myrtilloides* (low bilberry), *Goodyera repens* (rattlesnake plantain), *Empetrum nigrum* (crowberry), *Cornus canadensis* (bunchberry), *Ledum groenlandicum* (Labrador tea) and reindeer lichens (*Cladina rangiferina, C. alpestris, Cetraria nivalis*).

Peatlands are mainly acidic, nutrient-poor bogs dominated by black spruce, tamarack, Labrador tea, reindeer lichens and peatmosses. Discontinuous permafrost is widespread in the peatlands. Fens are rare due to the acidic nature of the bedrock and soils, as well as the rocky lake shores.

Wildlife

Characteristic species of upland jack pine forests include common nighthawk, gray jay, common raven, boreal chickadee, American robin, hermit thrush, dark-eyed junco, red squirrel, varying hare, lynx and black bear. Wetland and open water species include common loon, lesser scaup, bufflehead, Bonaparte's gull, spotted sandpiper, alder flycatcher, rusty blackbird, red-winged blackbird, rusty blackbird, moose, beaver and mink.

Bald eagle and osprey are widely distributed throughout the Subregion, nesting near the numerous lakes. Golden eagle, which does not breed in the Boreal Forest, nests locally on cliffs. Rare peregrine falcons have also nested on cliffs in the area.

Northern shrike and arctic loon are both subarctic species that have bred in the Subregion. Winter visitors from further north include willow ptarmigan and, occasionally, barren ground caribou and arctic fox.

4. NATURAL HISTORY THEMES

Natural history themes are a way of organizing information about landscape features, both physical and biotic, in a non-spatial manner, within the Subregion level. The system used here was previously developed for ecological reserves and provincial parks planning purposes (Achuff et al. 1988, Cottonwood Consultants Ltd. 1983) and is modified to reflect changes in the Natural Regions and Subregions classification.

Information on the themes is presented here at the Level 1 and Level 2 categories (Achuff et al. 1988). Level 1 information is the broadest and includes major, visible landform and biotic complexes, and highly significant major ecosystem types. These can be recognized on air photos and on regional geological and soils maps. Level 2 information is more detailed and includes broad vegetation types, soil Great Groups, bedrock classes, highly visible and large surficial geological components, and unusual vegetation assemblages and habitats. Level 2 components can be assessed from reconnaissance field studies. Level 3 information, which is not presented here, describes features typical of Level 2 themes. These include plant community types, soil subgroups, bedrock types, rare species, occupy relatively small areas, and require detailed field surveys.

Additionally, special features, which are restricted in areal extent and contain rare or unusual landforms or biotic features, are described for each Subregion.

Not all of the more than 200 significant features recently identified for the southeastern boreal forest (D.A. Westworth and Associates Ltd. 1990) are included here because of space limitations and because many are regarded as Level 3 themes.

4.1 THEME COMPONENTS - DRY MIXEDGRASS SUBREGION

LEVEL 1	LEVEL 2
NON-SANDY UPLAND	
GLACIAL LAKE BED	Grassland
GROUND MORAINE	Grassland
	Brown Chernozem
	Solonetzic
	Heavily Grazed
	Un-/Lightly Grazed
	Eroded Plain
HUMMOCKY MORAINE	Grassland
	Brown Chernozem
	Heavily Grazed
	Un-/Lightly Grazed
SANDY UPLAND	
SANDY PLAIN	Grassland
	Heavily Grazed
	Recently Burned
	Meltwater (delta) Complex

DUNE FIELD	Active Sand
	Grassland
	Low Shrubland
	Tall Shrubland
	Forest
	Recently Burned Dunes
VALLEY/RIDGE	
EXPOSED SLOPE	Spillway Channel
	Ravine
	Extensive Badlands
	Eroded Bedrock
	Shale/Mudstone
	Soft Sandstone
	Massive Sandstone
	Till
	Fine-textured Glacial Lake Deposits
	Coarse-textured Glacial Lake Deposits
	Valley Rim
PROTECTED SLOPE	Low Shrubland
	Tall Shrubland
	Forest
SPRINGS	Springs - Alkaline
	Springs - Fresh
FLOOR/STREAM	Inactive Terrace
	Riparian
	Low Shrubland
	Tall Shrubland
	Forest
	Active Channel
	Recently Inundated
	Abandoned Channel
	Sinuous Stream
	Meandering Stream
Turbid Stream	
	Clear Stream
	Intermittent Stream
	Permanent Stream
WETLAND	
WET MEADOW	Wet Meadow
	Non-/Slightly Saline
	Saline
	Sandy Ephemeral
SHALLOW MARSH	Shallow Marsh
	Open Water
DEEP MARSH	Deep Marsh
	Open Water
ALKALI WETLAND	Open Alkali Wetland
SPECIAL	
MILK RIVER ECOSYSTEM	Eroding Slopes
	Sand Plains
	Oxbow Lakes
	Milk River Canyon
	Igneous Dikes
	Police Coulee
OTHER	South Saskatchewan River Canyon
	Pakowki Lake
	Extensive Marshes
	Bird Nesting Islands
	Active Sand Dunes
	Red Rock Coulee
	Ice-thrust Ridge
	Glacially Streamlined Terrain
	Meteorite Impact Crater

4.2 THEME COMPONENTS - MIXEDGRASS SUBREGION

LEVEL 1	LEVEL 2
NON-SANDY UPLAND	
GLACIAL LAKE BED	Grassland
GROUND MORAINE	Grassland
	Dark Brown Chernozem
	Solonetzic
	Heavily Grazed
	Un-/Lightly Grazed
	Eroded Plain
HUMMOCKY MORAINE	Grassland
	Dark Brown Chernozem
	Heavily Grazed
	Un-/Lightly Grazed
SANDY UPLAND	
SANDY PLAIN	Grassland
	Heavily Grazed
	Recently Burned
	Meltwater (delta) Complex
DUNE FIELD	Active Sand
	Grassland
	Low Shrubland
	Tall Shrubland
	Forest
	Recently Burned Dunes
VALLEY/RIDGE	
EXPOSED SLOPE	Spillway Channel
	Ravine
	Extensive Badlands
	Eroded Bedrock
	Shale/Mudstone
	Soft Sandstone
	Massive Sandstone
	Till
	Fine-textured Glacial Lake Deposits
	Coarse-textured Glacial Lake Deposits
	Valley Rim
PROTECTED SLOPE	Low Shrubland
	Tall Shrubland
	Forest
SPRINGS	Springs - Alkaline
	Springs - Fresh
FLOOR/STREAM	Inactive Terrace
	Riparian
	Low Shrubland
	Tall Shrubland
	Forest
	Active Channel
	Recently Inundated
	Abandoned Channel
	Sinuous Stream
	Meandering Stream
	Turbid Stream
	Clear Stream
	Intermittent Stream
	Permanent Stream
WETLAND	
WET MEADOW	Wet Meadow
	Non-/Slightly Saline
	Saline
	Sandy Ephemeral
SHALLOW MARSH	Shallow Marsh
	Open Water
DEEP MARSH	Deep Marsh
	Open Water
ALKALI WETLAND	Open Alkali Wetland

SPECIAL	
OTHER	Glacially Streamlined Terrain
	Glacial Megablock

4.3 THEME COMPONENTS - NORTHERN FESCUE SUBREGION

LEVEL 1	LEVEL 2
NON-SANDY UPLAND	
GLACIAL LAKE BED	Grassland
GROUND MORAINE	Grassland
	Non-Solonetzic
	Solonetzic
	Heavily Grazed
	Un-/Lightly Grazed
	Ground Moraine
HUMMOCKY MORAINE	Grassland
	Low Shrubland
	Tall Shrubland
SANDY UPLAND	
SANDY PLAIN	Grassland
	Low Shrubland
DUNE FIELD	Grassland
	Low Shrubland
VALLEY/RIDGE	
EXPOSED SLOPE	Extensive Badlands
	Ravine
	Eroded Bedrock
	Shale/Mudstone
	Soft Sandstone
	Massive Sandstone
	Till
	Fine-textured Glacial Lake Deposits
	Valley Rim
PROTECTED SLOPE	Low Shrubland
	Tall Shrubland
	Forest
SPRINGS	Springs - Alkaline
	Springs - Fresh
FLOOR/STREAM	Inactive Terrace
	Sagebrush Flat
	Riparian
	Low Shrubland
	Tall Shrubland
	Forest
	Active Channel
	Recently Inundated
	Abandoned Channel
	Turbid Stream
	Clear Stream
	Intermittent Stream
	Permanent Stream
WETLAND	
WET MEADOW	Wet Meadow
	Non-/Slightly Saline
	Saline
SHALLOW MARSH	Shallow Marsh
	Open Water
DEEP MARSH	Deep Marsh
	Open Marsh
ALKALI WETLAND	Open Alkali Wetland
LAKE	Lake
	Fresh/Slightly Saline
	Saline
SPECIAL	Hand Hills
	Wintering Hills
	Ice-thrust Ridge

4.4 THEME COMPONENTS - FOOTHILLS FESCUE SUBREGION

LEVEL 1	LEVEL 2
NON-SANDY UPLAND	
GLACIAL LAKE BED	Grassland
GROUND MORAINE	Grassland
HUMMOCKY MORAINE	Grassland
	Low Shrubland
	Tall Shrubland
SANDY UPLAND	
SANDY PLAIN	Grassland
	Sand Dunes
VALLEY/RIDGE	
EXPOSED SLOPE	Eroded Bedrock
	Till
	Fine-textured Glacial Lake Deposits
	Coarse-textured Glacial Lake Deposits
PROTECTED SLOPE	Low Shrubland
	Tall Shrubland
	Forest
SPRINGS	Springs
FLOOR/STREAM	Inactive Terrace
	Riparian
	Low Shrubland
	Tall Shrubland
	Forest
	Active Channel
	Recently Inundated
	Abandoned Channel
	Sinuous Stream
	Meandering Stream
	Turbid Stream
	Clear Stream
	Intermittent Stream
	Permanent Stream
RIDGE/VALLEY WALL	Bedrock
	Grassland
WETLAND	
WET MEADOW	Wet Meadow
SHALLOW MARSH	Shallow Marsh
	Open Water
DEEP MARSH	Deep Marsh
	Open Marsh
SPECIAL	Sweetgrass Hills
	Permanent Stream
	Foothills Grassland
	Milk River Ridge
	Unglaciated Terrain
	Cypress Hills
	Glaciated Slopes
	Unglaciated Plateau
	Belly Buttes
	McNeill Erratics Train
	Foothills Erratic Train

4.5 THEME COMPONENTS - CENTRAL PARKLAND SUBREGION

LEVEL 1	LEVEL 2
NON-SANDY UPLAND	
GLACIAL LAKE BED	Grassland
	Low Shrubland
	Tall Shrubland
	Forest
	Pitted Delta
GROUND MORAINE	Grassland
	Non-Solonetzic

	Solonetzic
	Low Shrubland
	Tall Shrubland
HUMMOCKY MORAINE	Grassland
	Low Shrubland
	Tall Shrubland
	Aspen Forest
	Balsam Poplar Forest
SANDY UPLAND	
SANDY PLAIN	Grassland
	Low Shrubland
	Tall Shrubland
	Aspen Forest
DUNE FIELD	Active Dune
	Stabilized Dune
	Juniper/Lichen
	Grassland
	Low Shrubland
	Tall Shrubland
	Aspen Forest
	Recently-burned Dunes
KAME MORAINE	Grassland
	Low Shrubland
	Tall Shrubland
	Aspen Forest
VALLEY/RIDGE	Mass-wasting Features
EXPOSED SLOPE	Eroded Bedrock
	Badlands
	Till
	Fine-textured Glacial Lake Deposits
	Coarse-textured Glacial Lake Deposits
	Valley Rim
PROTECTED SLOPE	Low Shrubland
	Tall Shrubland
	Forest
SPRINGS	Springs - Alkaline
	Springs - Fresh
FLOOR/STREAM	Riparian
	Low Shrubland
	Tall Shrubland
	Forest
	Active Channel
	Recently Inundated
	Abandoned Channel
	Sinuous Stream
	Meandering Stream
	Clear Stream
	Intermittent Stream
	Permanent Stream
WETLAND	
WET MEADOW	Wet Meadow
	Non-/Slightly Saline
	Saline
SHALLOW MARSH	Shallow Marsh
	Open Water
DEEP MARSH	Deep Marsh
	Open Marsh
	Beaver Pond
ALKALI WETLAND	Open Alkali Wetland
LAKE	Lake
	Fresh/Slightly Saline
	Saline
SPECIAL	Beaverhills Lake
	Ice-thrust Ridge
	Eastern Sand Plain Lakes
	Reflex Lake
	Sounding Lake
	David Lake Fens
	Fen-Beaver Pond Complex

Slope Fen
Glacial Megablock
Glacially Streamlined Terrain
Gwynne Outlet - Battle River Glacial Spillway Channel
Esker Field
Buried Channels
Lousana Canyon

4.6 THEME COMPONENTS - FOOTHILLS PARKLAND

LEVEL 1	LEVEL 2
NON-SANDY UPLAND	
GLACIAL LAKE BED	Grassland
	Low Shrubland
	Tall Shrubland
	Forest
	Pitted Delta
GROUND MORAINE	Grassland
	Non-Solonetzic
	Solonetzic
	Low Shrubland
	Tall Shrubland
HUMMOCKY MORAINE	Grassland
	Low Shrubland
	Tall Shrubland
	Aspen Forest
	Balsam Poplar Forest
SANDY UPLAND	
SANDY PLAIN	Grassland
	Low Shrubland
	Tall Shrubland
	Aspen Forest
DUNE FIELD	Active Dune
	Stabilized Dune
	Juniper/Lichen Grassland
	Low Shrubland
	Tall Shrubland
	Aspen Forest
	Recently Burned Dunes
KAME MORAINE	Grassland
	Low Shrubland
	Tall Shrubland
	Aspen Forest
VALLEY/RIDGE	Mass-wasting Features
EXPOSED SLOPE	Eroded Bedrock
	Badlands
	Till
	Fine-textured Glacial Lake Deposits
	Coarse-textured Glacial Lake Deposits
	Valley Rim
PROTECTED SLOPE	Low Shrubland
	Tall Shrubland
	Forest
SPRINGS	Springs - Alkaline
	Springs - Fresh
FLOOR/STREAM	Riparian
	Low Shrubland
	Tall Shrubland
	Forest
	Active Channel
	Recently Inundated
	Abandoned Channel
	Sinuous Stream
	Meandering Stream

	Clear Stream
	Intermittent Stream
	Permanent Stream
WETLAND	
WET MEADOW	Wet Meadow
	Non-/Slightly Saline
	Saline
SHALLOW MARSH	Shallow Marsh
	Open Water
DEEP MARSH	Deep Marsh
	Open Marsh
	Beaver Pond
ALKALI WETLAND	Open Alkali Wetland
LAKE	Lake
	Fresh/Slightly Saline
	Saline
SPECIAL	
WATERTON-CROWSNEST ECOSYSTEM	
OTHER	Foothills Erratic Train
	Carway Iris Site

4.7 THEME COMPONENTS - PEACE RIVER PARKLAND

LEVEL 1	LEVEL 2
NON-SANDY UPLAND	
GLACIAL LAKE BED	Grassland
	Low Shrubland
	Tall Shrubland
	Forest
VALLEY/RIDGE	Mass-wasting Features
EXPOSED SLOPE	Eroded Bedrock
	Grassland
PROTECTED SLOPE	Springs
	Low Shrubland
	Tall Shrubland
	Forest
FLOOR/STREAM	River Terrace
	Tall Shrubland
	Forest
	Turbid Stream
	Clear Stream
	Intermittent Stream
	Permanent Stream
WETLAND	
WET MEADOW	Wet Meadow
SHALLOW MARSH	Shallow Marsh
	Open Water
DEEP MARSH	Deep Marsh
	Open Marsh
LAKE	Lake
SPECIAL	Kleskun Hill

4.8 THEME COMPONENTS - LOWER FOOTHILLS SUBREGION

LEVEL 1	LEVEL 2
VALLEY/RIDGE	
RIDGE/VALLEY WALL	Morainal
	Colluvial
	Lodgepole Pine Forest
	White Spruce Forest
	Black Spruce Forest
	Aspen-Spruce Forest
	Aspen Forest
	Birch Forest

	Recently-burned Forest
	Grassland
	Exposed Bedrock
	Sandstone
	Shale
FLOOR/STREAM	Outwash
	Fluvial
	Glaciofluvial
	Glaciolacustrine
	Spring-Seepage
	Lodgepole Pine Forest
	White Spruce Forest
	Black Spruce Forest
	Poplar-Spruce Forest
	Aspen Forest
	Balsam Poplar Forest
	Shrubland
	River
	Muskeg Stream
WETLAND	
MINERAL	Swamp
	Marsh
	Black Spruce Forest
	Shrubland
ORGANIC	Bog
	Patterned Fen
	Non-patterned Fen
	Black Spruce Forest
	Tamarack Forest
	Shrubland
	Graminoid Communities
LAKE	Mesotrophic Lake
	Dystrophic Lake
SPECIAL	Clear Hills Iron Deposits

4.9 THEME COMPONENTS - UPPER FOOTHILLS SUBREGION

LEVEL 1	LEVEL 2
VALLEY/RIDGE	
RIDGE/VALLEY WALL	Morainal
	Colluvial
	Lodgepole Pine Forest
	White Spruce Forest
	Spruce-Fir Forest
	Black Spruce Forest
	Recently-burned Forest
	Exposed Bedrock
	Sandstone
	Shale
FLOOR/STREAM	Outwash
	Fluvial
	Glaciofluvial
	Glaciolacustrine
	Spring-Seepage
	Lodgepole Pine Forest
	White Spruce Forest
	Black Spruce Forest
	Shrubland
	River
	Muskeg Stream
WETLAND	
MINERAL	Swamp
	Marsh
	Black Spruce Forest
	Shrubland
ORGANIC	Patterned Fen

	Non-Patterned Fen
	Black Spruce Forest
	Shrubland
	Graminoid Communities
LAKE	Mesotrophic Lake
SPECIAL	Foothills Erratic Train
	Unglaciated Terrain
	Ram River Falls
	Coal Valley
	Swan Hill
	Goose Mountain
	Giant Glacial Flutings

4.10 -COMPONENTS - MONTANE SUBREGION

LEVEL 1	LEVEL 2
VALLEY/RIDGE	
FLOOR/STREAM	Outwash
	Fluvial
	Glaciofluvial
	Lacustrine
	Springs/Seepage
	Douglas Fir Forest
	Spruce Forest
	Lodgepole Pine Forest
	Limber Pine Forest
	Aspen Forest
	Balsam Poplar Forest
	Shrublands
	Grassland
	River
RIDGE/VALLEY WALL	Douglas Fir Forest
	Recently-burned Forest
	Spruce Forest
	Lodgepole Pine Forest
	Limber Pine Forest
	Aspen Forest
	Shrublands
	Grassland
	Moraine
	Bedrock
	Colluvium
WETLAND	
MINERAL	Spruce Forest
	Deciduous Forest
	Shrubland
	Marsh
SPECIAL	
WATERTON-CROWSNEST ECOSYSTEM	
OTHER	Valley Glacier Features
	Dunes
	Waterfalls
	Cypress Hills
	Kootenay Plains
	Whaleback Ridge
	Vermilion Lakes
	Yamnuska Area
Maskinonge Complex	
	Hoodoos
	Canyons
	Frank Slide
	Karst Springs
	Hot Springs
	Cold Sulphur Springs
	Mineral Springs
	Burmis Magnetite
	Crowsnest Volcanics

4.11 THEME COMPONENTS - SUBALPINE SUBREGION

LEVEL 1	LEVEL 2
VALLEY/RIDGE	
FLOOR/STREAM	Outwash
	Fluvial
	Glaciofluvial
	Lacustrine
	Morainal
	Spruce Forest
	Old Growth Forest
	Lodgepole Pine Forest
	Deciduous Forest
	Recently Burned Forest
	Shrublands
	Grassland
	River
	Braided Stream
	Canyon
	Muskeg Stream
RIDGE/VALLEY WALL	Main Ranges
	Front Ranges
	Bedrock
	Non-calcareous
	Calcareous
	Colluvial
	Morainal
	Snow Avalanche Slopes
	Timberline/Krummholz
	Lower Subalpine
	Upper Subalpine
	Spruce-Fir Forest
	Old Growth Forest
	Lodgepole Pine Forest
	Whitebark Pine Forest
	Subalpine Larch Forest
	Deciduous Forest
	Recently Burned Forest
	Shrublands
	Grassland and Meadows
WETLAND	
MINERAL	Coniferous Forest
	Shrubland
ORGANIC	Coniferous Forest
	Shrubland
	Graminoid Communities
LAKE	Lake
SPECIAL	
KAKWA-NORTH WILLMORE ECOSYSTEM	
WATERTON-CROWSNEST ECOSYSTEM	
OTHER	Rock Glacier
	Karst Topography
	Castleguard Caves
	Neoglacial Landscapes
	Red Beds
	Lewis Thrust/Klippe
	McConnell Thrust
	Coral Reef
	Flowstone
	Waterfalls
	Gypsum and Anhydrite
	Granitoid Stocks
	Purcell Sills and Dikes

4.12 THEME COMPONENTS - ALPINE SUBREGION

LEVEL 1	LEVEL 2
VALLEY/RIDGE	
FLOOR/STREAM	Fluvial
	Morainal
	Colluvial
	Moderate Snowbed Communities
	Deep Snowbed Communities
	Stream
RIDGE/VALLEY WALL	Bedrock Structures
	Tectonic
	Landforms
	Bedrock
	Non-calcareous
	Calcareous
	Alpine Glaciation
	Morainal
	Colluvial
	Shallow Snow Communities
	Moderate Snowbed Communities
	Deep Snowbed Communities
	Moist Meadow
GLACIER/SNOWFIELD	Glacier
	Snowfield
WETLAND	
MINERAL	Wet Meadow
LAKE	Lake
SPECIAL	
KAKWA-NORTH WILLMORE ECOSYSTEM	
WATERTON-CROWSNEST ECOSYSTEM	
OTHER	Plateau Mountain
	Columbia Icefields
	Neoglacial Landscapes

4.13 THEME COMPONENTS - DRY MIXEDWOOD SUBREGION

LEVEL 1	LEVEL 2
NON-SANDY UPLAND	
GROUND MORAINE	White Spruce Forest
	Black Spruce Forest
	Mixedwood Forest
	Deciduous Forest
	Recently-burned Forest
HUMMOCKY MORAINE	White Spruce Forest
	Black Spruce Forest
	Mixedwood Forest
	Deciduous Forest
	Recently-burned Forest
SANDY UPLAND	
DUNE FIELD	Stabilized Dunes
	Jack Pine Forest
	Recently-burned Forest
SANDY PLAIN	Jack Pine Forest
	Deciduous Forest
	Recently-burned Forest
VALLEY/RIDGE	
PROTECTED SLOPE	White Spruce Forest
	Mixedwood Forest
	Deciduous Forest
FLOOR/STREAM	White Spruce Forest
	Black Spruce Forest
	Mixedwood Forest
	Deciduous Forest
	River

	Muskeg Stream
WETLAND	
MINERAL	Marsh
	Swamp
	White Spruce Forest
	Black Spruce Forest
	Shrubland
ORGANIC	Bog
	Patterned Fen
	Non-patterned Fen
	Black Spruce Forest
	Tamarack Forest
	Shrubland
	Graminoid Communities
LAKE	Eutrophic Lake
	Mesotrophic Lake
SPECIAL	Balsam Fir Forest

4.14 THEME COMPONENTS - CENTRAL MIXEDWOOD SUBREGION

LEVEL 1	LEVEL 2
NON-SANDY UPLAND	
GROUND MORAINE	White Spruce Forest
	Black Spruce Forest
	Mixedwood Forest
	Deciduous Forest
	Recently-burned Forest
HUMMOCKY MORAINE	Hill and Hole Topography
	White Spruce Forest
	Black Spruce Forest
	Mixedwood Forest
	Deciduous Forest
	Recently-burned Forest
SANDY UPLAND	
DUNE FIELD	Stabilized Dunes
	Jack Pine Forest
	Recently-burned Forest
SANDY PLAIN	Jack Pine Forest
	Deciduous Forest
	Recently-burned Forest
VALLEY/RIDGE	
PROTECTED SLOPE	White Spruce Forest
	Mixedwood Forest
	Deciduous Forest
EXPOSED SLOPE	Eroded Bedrock
	Limestone
	Shale
	Sandstone
FLOOR/STREAM	White Spruce Forest
	Black Spruce Forest
	Mixedwood Forest
	Deciduous Forest
	River
	Muskeg Stream
WETLAND	
MINERAL	Marsh
	Swamp
	White Spruce Forest
	Black Spruce Forest
	Shrubland
ORGANIC	Bog
	Patterned Fen
	Non-patterned Fen
	Black Spruce Forest
	Tamarack Forest
	Shrubland

	Graminoid Communities
LAKE	Eutrophic Lake
	Mesotrophic Lake
	Oligotrophic Lake
SPECIAL	Whitemud Falls
	La Saline Springs
	Grand Rapids Springs
	Bitumen Exposures
	Giant Glacial Flutings
	Balsam Fir Forest
	Incised Meanders
	Abandoned Beach Ridges
	Trout River Delta

4.15 THEME COMPONENTS - WETLAND MIXEDWOOD SUBREGION

LEVEL 1	LEVEL 2
NON-SANDY UPLANDS	
GLACIAL LAKE BED	White Spruce Forest
	Black Spruce Forest
	Mixedwood Forest
GROUND MORAINE	White Spruce Forest
	Black Spruce Forest
	Mixedwood Forest
	Aspen Forest
SANDY UPLAND	
SANDY PLAIN	Dune Field
	Jack Pine Forest
	Recently-burned Forest
VALLEY/RIDGE	
FLOOR/STREAM	Stream Terrace
	Mixedwood Forest
	River
	Muskeg Stream
WETLAND	
MINERAL	Shrubland
ORGANIC	Bog
	Patterned Fen
	Non-Patterned Fen
	Black Spruce Forest
	Shrubland
	Graminoid Communities
LAKE	Eutrophic Lake
	Mesotrophic Lake
	Dystrophic Lake
SPECIAL	Saline Plains
	Karst Topography
	Hay-Zama Lakes
	Hay River Meanders
	Whooping Crane Nesting Habitat

4.16 THEME COMPONENTS - BOREAL HIGHLANDS SUBREGION

LEVEL 1	LEVEL 2
NON-SANDY UPLAND	
GROUND MORAINE	White Spruce Forest
	Black Spruce Forest
	Mixedwood Forest
	Deciduous Forest
	Recently-burned Forest
HUMMOCKY MORAINE	White Spruce Forest
	Black Spruce Forest
	Mixedwood Forest
	Deciduous Forest
	Recently-burned Forest

SANDY UPLAND	
DUNE FIELD	Stabilized Dunes
	Jack Pine Forest
	Recently-burned Forest
VALLEY/RIDGE	
PROTECTED SLOPE	White Spruce Forest
	Mixedwood Forest
	Deciduous Forest
FLOOR/STREAM	White Spruce Forest
	Black Spruce Forest
	Mixedwood Forest
	Deciduous Forest
	River
	Muskeg Stream
WETLAND	
MINERAL	Marsh
	Swamp
	White Spruce Forest
	Black Spruce Forest
	Shrubland
ORGANIC	Bog
	Patterned Fen
	Non-patterned Fen
	Black Spruce Forest
	Tamarack Forest
	Shrubland
	Graminoid Communities
LAKE	Eutrophic Lake
	Mesotrophic Lake
	Oligotrophic Lake
SPECIAL	Giant Glacial Flutings
	Birch Mountains
	Christina River Peatlands

4.17 THEME COMPONENTS - PEACE RIVER LOWLANDS SUBREGION

LEVEL 1	LEVEL 2
NON-SANDY UPLAND	
GLACIAL LAKE BED	Black Spruce Forest
	White Spruce Forest
	Mixedwood Forest
	Saline Grasslands
VALLEY/RIDGE	
FLOOR/STREAM	River Meander Complex
	Jack Pine Forest
	Black Spruce Forest
	White Spruce Forest
	Mixedwood Forest
	Recently-burned Forest
WETLAND	
MINERAL	Marsh
	Swamp
	Open Water
	Black Spruce Forest
	White Spruce Forest
	Mixedwood Forest
	Shrubland
	Graminoid Communities
ORGANIC	Bog
	Fen
	Black Spruce Forest
	Shrubland
	Graminoid Communities
SPECIAL	
PEACE - ATHABASCA DELTA	

	Birdsfoot Delta
	Waterfowl Staging Habitat
	Precambrian Bedrock Outcrops
	Lake Claire
SALT PLAINS	Saline Plains
OTHER	Slave River Rapids
	Peace Point Gypsum
	Vermilion Chutes
	Karst Topography
	Bison Habitat

4.18 THEME COMPONENTS - SUBARCTIC SUBREGION

LEVEL 1	LEVEL 2
NON-SANDY UPLAND	
GROUND MORAINE	Black Spruce Forest
	White Spruce Forest
	Lodgepole Pine Forest
	Aspen Forest
	Recently-burned Forest
VALLEY-RIDGE	
PROTECTED SLOPE	Mixedwood Forest
	Incised Stream
WETLAND	
MINERAL	Shrubland
	Muskeg Stream
ORGANIC	Bog
	Patterned Fen
	Permafrost Terrain
	Non-patterned Fen
	Black Spruce Forest
	Shrubland
	Herb Communities
LAKE	Oligotrophic Lake
	Dystrophic Lake
SPECIAL	Giant Glacial Flutings
	Bistcho Lake
	Birch Mountains

4.19 THEME COMPONENTS - ATHABASCA PLAIN SUBREGION

LEVEL 1	LEVEL 2
SANDY UPLAND	
SANDY PLAIN	Coniferous Forest
	Deciduous Forest
	Recently-burned Forest
	Erosional Features
DUNE FIELD	Active Dune
	Stabilized Dune
	Paleodune
KAME COMPLEX	Ice-contact Features
	Kame Moraine
	Crevasse Filling
	Conifer Forest
	Recently-burned Forest
VALLEY/RIDGE	
FLOOR/STREAM	River
	Muskeg Stream
WETLAND	
ORGANIC	Bog
	Forest
	Fen
	Graminoid

	Tamarack
	Shrub
MINERAL	Marsh
	Wet Dune Slacks
	Lagoon
LAKE	Oligotrophic Lake
	Mesotrophic Lake
SPECIAL	
LAKE ATHABASCA NORTH SHORE	
	Beach Vegetation
	Beach Ridge
	Athabasca Sandstone
	Sand Spit
LAKE ATHABASCA SOUTH SHORE/ISLANDS	
	Island
	South Shore
	Beach Vegetation
	White Spruce Park-like Forest
	Caspian Tern Colony
	De Geer Moraine
OTHER	Athabasca Dunes
	Crag and Tail
	Giant Flutings and Drumlinoid Features

4.20 THEME COMPONENTS - KAZAN UPLAND SUBREGION

LEVEL 1	LEVEL 2
NON-SANDY UPLAND	
BEDROCK	Granitoids
	Gneisses
	Metasedimentary
	Erosional Features
	Cliff
	Lichen Communities
	Crevice Communities
	Dwarf Shrub
	Forest
SANDY UPLAND	
SANDY PLAIN	Glacial Features
	Coniferous Forest
	Recently-burned Forest
	Deciduous Forest
VALLEY/RIDGE	
FLOOR/STREAM	River
	Muskeg Stream
WETLAND	
ORGANIC	Bog
	Forest
	Fen
	Gframinoid
	Tamarack
	Shrub
MINERAL	Forest
	Tall Shrubland
	Low Shrubland
	Wet Meadow
	Shallow Marsh
LAKE	Oligotrophic Lake
	Mesotrophic Lake
	Lake Shore
SPECIAL	Waugh Lake Volcanics
	Glacial Lake Berg Complex
	Colin Lake Grasslands
	Colin Lake Wetlands
	Paleozoic/Precambrian Unconformity

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6.0 GLOSSARY

6.1 Level 1 Theme Terms

Grassland, Parkland, Boreal Forest and Canadian Shield Terms

Bedrock - applies only to upland Precambrian bedrock outcrops in the Canadian Shield, Kazan Upland Subregion. All other bedrock types occur under Valley/Ridge Themes.

Dune Field - sandy deposits arranged by wind into dune formations. Although there are minor dunes within the mountains, this Theme is not represented at Level 1 in foothill and mountain environments.

Exposed Slope - valley slopes with exposed bedrock at the surface; a Theme confined largely to southern Alberta and Mixedwood Subregions..

Floor/Stream - applies to stream-influenced valley bottoms including the stream channel and related riparian woodland and shrubbery.

Glacial Lake Bed - predominantly fine-grained glacial lake deposits in plains areas. It may also include ground moraines with a thin veneer of fine glacial lake deposits. This term does not apply in Foothills, Mountain and Canadian Shield environments.

Ground Moraine - flat to undulating moraine of low relief, including draped and stagnation moraine. While this term is generally consistent across all regions, some areas of hummocky moraine are lumped with into Ground Moraine in the Foothills Parkland since it is a minor component of this Subregion. Predominantly sandy phases are included under Sandy Plain. This term does not apply in Foothills, Mountain and Canadian Shield environments.

Hummocky Moraine - moderately to strongly undulating knob and kettle topography, including stagnation, ridged-end and ice-thrust moraine. This term does not apply in Foothills, Mountain and Canadian Shield environments.

Kame Moraine - hummocky sandy terrain that has been deposited in mounds by meltwater in contact with glacier ice; a group of interconnecting kames. This is a significant landscape in only the Central Parkland and Athabasca Plain Subregions.

Lake - any siz able body of water, whether fresh or alkaline.

Non-Sandy Upland - a variety of plains landscapes that are morainal or glaciolacustrine in nature. Note that there are sandy ground moraines and sandy glaciolacustrine deposits that are included under the Sandy Upland-Sandy Plain Theme.

Protected Slope - vegetated valley slopes; a Theme confined largely to southern Alberta and Mixedwood Subregions.

Sandy Plain - fairly level and sandy terrain derived from ice-contact fluvial or lacustrine deposits and, in rare circumstances, on sandy morainal materials. This Theme is not represented in foothill and mountain environments.

Sandy Upland - a variety of plains landscapes that are characterized by thick deposits of coarse sand. This includes some areas of sandy moraine, lake deposits as well as the more typical dune fields, kames and outwash plains. This Theme is not represented in foothill and mountain environments.

Springs - while not strictly a valley feature, most springs occur in valleys and are included under the Valley/Ridge Themes. There are some springs on upland sites adjacent to lakes and other wetlands.

Valley/Ridge - valleys in the plains area encompassing a variety of valley slopes, river terraces and springs Themes.

Wetland - in southern Alberta plains, refers largely to non-woody meadow and marsh vegetation. In northern Alberta, it refers mainly to mineral and organic wetlands, many of which have woody cover. It also includes the Lake Theme which is widely distributed.

Foothills and Mountains Terms

Floor/Stream - applies to stream-influenced valley bottoms including the stream channel and related riparian woodland and shrubbery.

Glacier-Snowfield - occurs only in the Alpine Subregion

Lake - any sizable body of water.

Mineral - wetlands with minimal peat accumulation. Includes marsh and swamp vegetation in areas outside the Parkland and Grassland Natural Regions.

Organic - wetlands with significant peat accumulation. Includes bog and fen vegetation.

Ridge/Valley Wall - a strictly non-plains term that applies largely to Foothills and Mountain Natural Regions but also to "foothills" portions of the Foothills Fescue and Foothills Parkland Subregions.

Valley/Ridge - includes most of the uplands in the Foothills and Rocky Mountain Subregions.

Wetland - refers mainly to mineral and organic wetlands, many of which have woody cover. It also includes the Lake Theme which is widely distributed.

6.2 Scientific Plant Names

Abies balsamea - balsam fir
Abies lasiocarpa - subalpine fir
Abronia micrantha - sand verbena
Acer glabrum - mountain maple
Acer negundo - Manitoba maple
Achillea millefolium - yarrow
Aconitum delphinifolium - monkshood
Acorus americanus - sweet flag
Actaea rubra - baneberry
Adenocaulon bicolor - pathfinder
Agropyron spp. - wheat grasses
Agropyron dasystachyum - northern wheat grass
Agropyron smithii - western wheat grass
Agropyron smithii var. molle - western wheat grass
Agropyron spicatum - bluebunch wheat grass
Agropyron trachycaulum var. unilaterale - bearded wheat grass
Agrostis exarata - spike redtop
Alisma plantago-aquatica - broad-leaved water plantain
Alnus crispa - green alder
Alnus tenuifolia - river alder
Amelanchier alnifolia - saskatoon
Anemone canadensis - Canada anemone
Anemone occidentalis - chalice-flower
Anemone patens - prairie crocus
Anemone richardsonii - yellow anemone
Angelica arguta - white angelica
Angelica dawsonii - yellow angelica
Angelica genuflexa - kneeling angelica
Antennaria anaphaloides - tall everlasting
Antennaria lanata - woolly everlasting
Antennaria luzuloides - woodrush everlasting
Antennaria monocephala - single-headed everlasting
Antennaria parvifolia - Nuttall's everlasting
Aquilegia formosa - red columbine
Aquilegia jonesii - limestone columbine
Aralia nudicaulis - wild sarsaparilla
Arctagrostis arundinacea - grass with no common name
Arctostaphylos uva-ursi - common bearberry
Arenaria congesta - capitate sandwort
Arnica cordifolia - heart-leaved arnica
Arnica latifolia - mountain arnica
Artemisia spp. - wormwoods
Artemisia campestris - northern wormwood
Artemisia cana - sagebrush
Artemisia dracunculus - dragonwort
Artemisia frigida - pasture sagewort
Artemisia furcata - wormwood
Artemisia ludoviciana - prairie sagewort
Artemisia tridentata - big sagebrush *Asclepias viridifolia* - green milkweed
Aster ciliolatus - Lindley's aster
Aster conspicuus - showy aster
Aster subspicatus - leafy aster
Astragalus kentrophyta - prickly milk vetch
Astragalus lotiflorus - low milk vetch
Astragalus purshii - Pursh's milk vetch
Astragalus spatulatus - tufted milk vetch
Astragalus vexilliflexus - few-flowered milk vetch
Atriplex truncata - wedgescale orache
Aulacomnium palustre - brown moss
Balsamorhiza sagittata - balsam-root
Beckmannia syzigachne - slough grass
Berberis repens - creeping mahonia
Besseya wyomingensis - kitten-tails
Betula nana - dwarf birch, includes *B.Xsargentii*, *glandulosa*, and *pumila*
Betula occidentalis - water birch
Betula papyrifera - paper birch
Boisduvalia glabella - smooth boisduvalia
Boschniakia rossica - ground-cone
Botrychium paradoxum - grape-fern
Bouteloua gracilis - blue grama
Bromus ciliatus - fringed brome
Bromus inermis spp. *pumpellianus* - northern awnless brome
Bupleurum americanum - thorough-wax
Calamagrostis spp. - reed grasses
Calamagrostis canadensis - marsh reed grass
Calamagrostis inexpansa - northern reed grass
Calamagrostis stricta - narrow reed grass
Calamagrostis rubescens - pine grass
Calamovilfa longifolia - sand grass
Caltha leptosepala - mountain marigold
Camassia quamash - blue camas
Campanula lasiocarpa - alpine harebell
Campanula rotundifolia - bluebell
Carex spp. - sedges
Carex aquatilis - water sedge
Carex atherodes - awned sedge
Carex concinnoides - northwestern sedge
Carex diandra - lesser panicled sedge
Carex filifolia - thread-leaved sedge
Carex geyeri - Geyer's sedge
Carex leptalea - bristle-stalked sedge
Carex limosa - shore sedge
Carex mertensii - Mertens' sedge
Carex misandra - few-flowered sedge
Carex nebrascensis - Nebraska sedge
Carex nigricans - black alp sedge
Carex obtusata - blunt sedge
Carex paupercula - poor sedge
Carex rostrata - beaked sedge
Carex siccata - dry sedge
Carex stenophylla - low sedge *Carex supina* - sedge
Carex vaginata - sheathed sedge
Carex xerantica - dryland sedge
Cassiope spp. - white mountain heathers
Cassiope mertensiana - Mertens' white mountain heather
Cassiope tetragona - four-angled white mountain heather
Castilleja cusickii - Cusick's paintbrush
Cerastium arvense - field chickweed
Cetraria spp. - ground lichens
Cetraria nivalis - ground lichen
Chamaedaphne calyculata - leather-leaf

Cheilanthes gracillima - lace lip-fern
Chrysothamnus nauseosus - rabbit-brush
Cirsium drummondii - short-stemmed thistle
Cladonia spp. - ground lichens
Cladina spp. - reindeer lichens
Cladina alpestris - reindeer lichen
Cladina rangiferina - reindeer lichen
Cladopodiella fluitans - liverwort
Claytonia lanceolata - western spring beauty
Clematis occidentalis - purple clematis
Clintonia uniflora - queen's-cup
Collinsia parviflora - blue-eyed mary
Comandra umbellata - pale comandra
Conimitella williamsii - conimitella
Cornus canadensis - bunchberry
Cornus stolonifera - red-osier dogwood
Corylus cornuta - beaked hazelnut
Coryphantha vivipara - pincushion cactus
Crataegus spp. - hawthorns
Crepis intermedia - small-flowered hawk's-beard
Cyperus schweinitzii - sand nut-grass
Cypripedium acaule - stemless lady's-slipper
Cypripedium montanum - mountain lady's-slipper
Danthonia spp. - oat grasses
Danthonia californica - intermediate oat grass
Danthonia parryi - Parry's oat grass
Delphinium bicolor - low larkspur
Delphinium glaucum - tall larkspur
Deschampsia caespitosa - tufted hair grass
Disporum hookeri - Hooker's fairy-bells
Disporum trachycarpum - fairy-bells
Distichlis stricta - salt grass
Dodecatheon spp. - shooting stars
Douglasia montana - Rocky Mountain douglasia
Draba longipes - whitlow-wort
Draba oligosperma - comb whitlow-wort
Draba praealta - whitlow-wort
Drepanocladus spp. - brown mosses
Drepanocladus revolvens - brown moss
Dryopteris filix-mas - male fern
Dryopteris fragrans - fragrant shield fern
Dryas drummondii - yellow mountain avens
Dryas octopetala - white mountain avens
Elaeagnus commutata - silverberry
Eleocharis palustris - creeping spike-rush
Eleocharis quinquefolia - small-flowered spike-rush
Elymus glaucus - smooth wild rye
Elymus innovatus - hairy wild rye
Elymus mollis - American dune grass
Empetrum nigrum - crowberry
Epilobium angustifolium - fireweed
Epilobium luteum - yellow willow-herb
Equisetum spp. - horsetails
Equisetum arvense - common horsetail
Erigeron caespitosus - tufted fleabane
Erigeron peregrinus - subalpine fleabane
Erigeron radicatus - dwarf fleabane
Erigeron speciosus - three-veined fleabane
Eriophorum spp. - cotton grasses
Eriogonum cernuum - nodding umbrella-plant
Eriogonum flavum - yellow umbrella-plant
Eriogonum ovalifolium - oval-leaved umbrella-plant
Eriogonum umbellatum - subalpine umbrella-plant
Erythronium grandiflorum - glacier lily
Festuca altaica - fescue
Festuca idahoensis - Idaho fescue
Festuca scabrella - rough fescue
Festuca subulata - bearded fescue
Fragaria virginiana - wild strawberry
Franseria acanthicarpa - bur ragweed
Galium boreale - northern bedstraw
Galium triflorum - sweet-scented bedstraw
Gaultheria humifusa - mountain teaberry
Gentiana calycosa - explorer's gentian
Gentianella detonsa - smaller fringed gentian
Geocaulon lividum - bastard toad-flax
Geranium richardsonii - white geranium
Geranium viscosissimum - sticky purple geranium
Geum macrophyllum - large-leaved avens
Geum triflorum - three-flowered avens
Glyceria spp. - manna grasses
Goodyera repens - lesser rattlesnake-plantain
Grindelia squarrosa - gumweed
Gutierrezia sarothrae - broomweed
Gymnocarpium jessoense - oak-fern
Haplopappus nuttallii - toothed ironplant
Haplopappus uniflorus - one-flowered goldenweed
Hedysarum alpinum - American sweetvetch
Heterotheca villosa - golden aster
Helianthus couplandii - prairie sunflower
Helictotrichon hookeri - Hooker's oat grass
Heracleum lanatum - cow parsnip
Hieracium albiflorum - white-flowered hawkweed
Hieracium cynoglossoides - houndstongue hawkweed
Hieracium triste - slender hawkweed
Hierochloe alpina - alpine sweetgrass
Hordeum jubatum - foxtail barley *Hudsonia tomentosa* - sand heather
Hydrophyllum capitatum - waterleaf
Hylocomium splendens - feather moss
Hymenoxis acaulis - butte marigold
Hypericum formosum - St. John's-wort
Hypericum majus - St. John's-wort
Iliamna rivularis - mountain hollyhock
Iris missouriensis - western blue iris
Isoetes echinospora - quillwort
Juncus spp. - rushes
Juncus balticus - wire rush
Juncus brevicaudatus - rush
Juncus filiformis - long-bracted rush
Juncus regelii - Regel's rush
Juniperus communis - low juniper
Juniperus horizontalis - creeping juniper
Kalmia polifolia - swamp laurel
Kobresia myosuroides - Bellard's kobresia
Koeleria macrantha - June grass
Koenigia islandica - koenigia
Larix laricina - tamarack
Larix lyallii - alpine larch
Larix occidentalis - western larch
Lathyrus ochroleucus - cream-colored peavine
Ledum glandulosum - glandular Labrador tea
Ledum groenlandicum - common Labrador tea
Ledum palustre ssp. *decumbens* - Labarador tea
Lewisia pygmaea - bitter-root
Liatris ligulistylis - meadow blazing star
Linum lewisii - wild blue flax
Linnaea borealis - twinflower
Lithospermum ruderale - woolly gromwell
Lomatium cous - cous biscuitroot
Lomatium dissectum - fern-leaved prairie parsley
Lomatium triternatum - western wild parsley
Lonicera dioica - twining honeysuckle
Lonicera involucrata - bracted honeysuckle
Lupinus spp. - lupines
Lupinus nootkatensis - Nootka lupine
Lupinus sericeus - silvery lupine
Luzula hitchcockii - smooth wood rush
Luzula piperi - Piper's wood rush
Lycopodium annotinum - stiff club-moss
Lycopodium inundatum - bog club-moss
Lycopodium selago - fir club-moss
Lygodesmia juncea - skeleton-weed
Maianthemum canadense - wild lily-of-the-valley
Melampyrum lineare - cow-wheat
Melica smithii - melic grass
Melica subulata - Alaska onion grass
Menyanthes trifoliata - buck-bean
Menziesia ferruginea - false huckleberry
Mertensia longiflora - long-flowered lungwort
Mertensia paniculata - tall lungwort *Microseris nutans* - nodding microseris
Microsteris gracilis - microsteris
Mimulus lewisii - red monkey-flower
Minuartia nuttallii - Nuttall's sandwort
Mitella nuda - bishop's-cap
Mitella pentandra - five-stamened mitrewort
Moehringia laterifolia - bluntleaf sandwort
Montia linearis - linear-leaved spring beauty
Montia parvifolia - littleleaf spring beauty

Muhlenbergia cuspidata - plain's muhly
Myriophyllum sp. - water milfoil
Nothocalais cuspidata - toothed microseris
Nuphar variegatum - yellow pond lily
Oenothera andina - obscure evening-primrose
Onosmodium variegatum var. *molle* - false gromwell
Oplopanax horridum - devil's-club
Opuntia fragilis - brittle prickly pear cactus
Opuntia polyacantha - plains prickly pear cactus
Oryzopsis exigua - little rice grass
Oryzopsis hymenoides - Indian rice grass
Osmorhiza occidentalis - western sweet-cicely
Osmorhiza purpurea - purple sweet-cicely
Oxytropis lagopus - hare-footed locoweed
Oxytropis viscida - viscid locoweed
Pachystima myrsinites - mountain lover
Papaver pygmaeum - alpine poppy
Paronychia sessiliflora - low whitlowwort
Pedicularis sudetica - lousewort
Peltigera aphthosa - ground lichen
Penstemon albertinus - green beard-tongue
Penstemon eriantherus - crested beard-tongue
Penstemon procerus - slender blue beard-tongue
Perideridia gairdneri - squaw-root
Petasites palmatus - palmate-leaved coltsfoot
Petasites sagittatus - arrow-leaved coltsfoot
Phacelia hastata - varileaf scorpion-weed
Phacelia lyallii - Lyall's scorpion-weed
Phacelia sericea - silky scorpion-weed
Phegopteris connectilis - shield fern
Philadelphus lewisii - mock orange
Phleum commutatum - mountain timothy
Phlox alyssifolia - blue phlox
Phlox hoodii - moss phlox
Phragmites australis - reed
Phyllodoce spp. - heathers
Phyllodoce glanduliflora - yellow heather
Picea engelmannii - Engelmann spruce
Picea glauca - white spruce
Picea mariana - black spruce
Pinguicula villosa - villose butterwort
Pinus albicaulis - whitebark pine
Pinus banksiana - jack pine
Pinus contorta - lodgepole pine
Pinus flexilis - limber pine *Pinus monticola* - western white pine
Plantago canescens - plantain
Plantago maritima - goose-tongue plantain
Plantago patagonica - Pursh's plantain
Pleurozium schreberi - feather moss
Poa spp. - bluegrasses
Poa cusickii - early bluegrass
Poa interior - inland bluegrass
Poa sandbergii - Sandberg bluegrass
Polemonium acutiflorum - Jacob's-ladder
Polemonium viscosum - skunkweed
Polygala paucifolia - fringed milkwort
Polygonum coccineum - water smartweed
Polypodium virginianum - polypody
Polytrichum juniperinum - moss
Polytrichum piliferum - moss
Populus angustifolia - narrow-leaved cottonwood
Populus balsamifera - balsam poplar, includes *P. trichocarpa*
Populus deltoides - plains cottonwood
Populus tremuloides - aspen
Potamogeton spp. - pondweed
Potentilla fruticosa - shrubby cinquefoil
Potentilla diversifolia - diverse-leaved cinquefoil
Potentilla glandulosa - sticky cinquefoil
Potentilla palustris - marsh cinquefoil
Prenanthes alata - western rattlesnake-root
Prenanthes sagittata - arrowleaf rattlesnake-root
Prunus pensylvanica - pin cherry
Prunus virginiana - choke cherry
Pseudotsuga menziesii - Douglas fir
Psoralea lanceolata - scurf pea
Ptilium crista-castrensis - feather moss
Puccinellia nuttalliana - salt meadow grass
Pyrola spp. - wintergreens
Pyrola asarifolia - pink wintergreen
Pyrola picta - white-veined wintergreen
Ranunculus cardiophyllus - heart-leaved buttercup
Ranunculus occidentalis - western buttercup
Ranunculus uncinatus - little buttercup
Rhamnus alnifolia - alder buckthorn
Rhododendron albiflorum - white-flowered rhododendron
Ribes oxyacanthoides - northern gooseberry
Ribes viscosissimum - sticky currant
Rosa spp. - roses
Rosa acicularis - prickly rose
Rosa woodsii - common wild rose
Rosus chamaemorus - cloudberry
Rubus parviflorus - thimbleberry
Rubus pubescens - sand dock
Ruppia maritima - wigeon-grass
Sagina nodosa - pearlwort
Sagittaria cuneata - arum-leaved arrowhead
Salicornia europea - samphire
Salix spp. - willows
Salix amygdaloides - peach-leaf willow
Salix arctica - arctic willow
Salix barrattiana - Barratt's willow
Salix bebbiana - beaked willow
Salix brachycarpa - short-capsuled willow
Salix candida - hoary willow
Salix discolor - pussy willow
Salix glauca - blue-green willow
Salix exigua - sandbar willow
Salix myrtillifolia - blueberry willow
Salix nivalis - snow willow
Salix pedicellaris - glaucous bog willow
Salix planifolia - tea-leaved willow
Salix pseudomonticola - mountain willow
Salix vestita - rock willow
Sambucus racemosa - elder
Saussurea americana - American saussurea
Saxifraga flagellaris - spider plant
Saxifraga mertensiana - wood saxifrage
Saxifraga nivalis - snow saxifrage
Saxifraga tricuspidata - three-toothed saxifrage
Schizachne purpurascens - false melic
Schizachyrium scoparius - little bluestem
Scholochloa festucacea - spangletop
Scirpus spp. - bulrush
Scirpus paludosus - prairie bulrush
Scorpidium scorpioides - aquatic moss
Sedum spp. - stonecrops
Sedum stenopetalum - wormleaf stonecrop
Selaginella densa - little club-moss
Senecio spp. - groundsels
Senecio foetidus - sweet-marsh groundsel
Senecio megacephalus - large-headed groundsel
Senecio streptanthifolius - few-leaved groundsel
Senecio triangularis - arrowleaf groundsel
Shepherdia argentea - thorny buffalo-berry
Shepherdia canadensis - Canadian buffalo-berry
Silene acaulis - moss campion
Silene drummondii - Drummond's cockle
Silene antirrhina - sleepy catchfly
Sium suave - water parsnip
Smilacina stellata - star-flowered solomon's-seal
Solidago spathulata - mountain goldenrod
Solidago missouriensis - low goldenrod
Sorbus scopulina - western mountain-ash
Sparganium eurycarpum - giant bur-reed
Spartina spp. - cord grasses
Spergularia marina - salt-marsh sand spurry
Sphaeralacea coccinea - scarlet mallow
Spiraea betulifolia - white meadowsweet
Spiraea densiflora - subalpine spiraea
Sphagnum spp. - peat mosses *Sphagnum angustifolium* - peat moss
Sphagnum capillaceum - peat moss
Sphagnum fuscum - peat moss
Sphagnum jensenii - peat moss
Sphagnum magellanicum - peat moss
Sphagnum riparium - peat moss
Sporobolus cryptandrus - sand dropseed
Stachys palustris - hedge nettle
Stellaria arenicola - starwort

Stipa spp. - spear grasses
Stipa columbiana - columbia needle grass
Stipa comata - spear grass
Stipa curtiseta - western porcupine grass
Stipa richardsonii - Richardson's needle grass
Stipa spartea - porcupine grass
Stipa viridula - green needle grass
Streptopus roseus - rosy twisted-stalk
Streptopus streptopoides - twisted-stalk
Suaeda calceoliformis - sea blite
Suksdorfia ranunculifolia - buttercup-leaved suksdorfia
Symphoricarpos albus - snowberry
Symphoricarpos occidentalis - buckbrush
Tanacetum huronense - tansy
Taxus brevifolia - western yew
Thalictrum occidentale - western meadow rue
Thalictrum venulosum - veiny meadow rue
Thellungiella salsuginea - salt water cress
Thermopsis rhombifolia - golden bean
Tiarella trifoliata - trefoil false mitrewort
Tomenthypnum falcifolium - brown moss
Tomenthypnum nitens - brown moss
Townsendia condensata - cushion townsendia
Townsendia parryi - Parry's townsendia
Tradescantia occidentalis - western spiderwort
Triglochin maritima - arrow-grass
Trisetum canescens - tall trisetum
Trisetum montanum - mountain trisetum
Trollius albiflorus - globe-flower
Typha latifolia - cattail
Utricularia cornuta - bladderwort
Vaccinium caespitosum - dwarf bilberry
Vaccinium membranaceum - tall bilberry
Vaccinium myrtilloides - Canada blueberry
Vaccinium myrtillus - low bilberry
Vaccinium scoparium - grouse-berry
Vaccinium uliginosum - bog bilberry
Vaccinium vitis-idaea - bog cranberry
Valeriana sitchensis - mountain valerian
Veronica alpina - alpine speedwell
Viburnum edule - low bush-cranberry
Viburnum opulus - high bush-cranberry
Vicia americana - American vetch
Viola macloskeyi - small white violet
Viola pedatifida - crowfoot violet *Viola canadensis* - western Canada violet
Viola selkirkii - great-spurred violet
Woodsia ilvensis - rusty woodsia
Woodsia oregana - Oregon woodsia
Xerophyllum tenax - bear grass
Yucca glauca - yucca

6.3 Common Plant Names

alder - *Alnus* spp.
arrowgrass, seaside - *Triglochin maritima*
avens, mountain - *Dryas octopetala*
aspen - *Populus tremuloides*
azalea, false - *Menziesia ferruginea*
bearberry - *Arctostaphylos uva-ursi*
birch, dwarf - *Betula nana* (includes *pumila* and *glandulosa*)
birch, paper - *Betula papyrifera*
birch, water - *Betula occidentalis*
bladderworts - *Utricularia* spp.
bladderwort, common - *Utricularia vulgaris*
blite, sea - *Suaeda calceoliformis*
bluebell - *Campanula rotundifolia*
bluestem, little - *Schizachyrium scoparius*
broomweed - *Gutierrezia sarothrae*
buckbrush - *Symphoricarpos occidentalis*
buffaloberry, Canada - *Shepherdia canadensis*
bulrush - *Scirpus* spp. (*acutus* & *validus*)
bulrush, prairie - *Scirpus paludosus*
bur-reeds - *Sparganium* spp.
cactus, fragile prickly pear - *Opuntia fragilis*
cattail - *Typha latifolia*
cedar, western red - *Thuja plicata*
cherry, choke or chokecherry - *Prunus virginiana*
cherry, pin - *Prunus pensylvanica*
cinquefoil - *Potentilla* spp.
cinquefoil, shrubby - *Potentilla fruticosa*
cloudberry - *Rubus chamaemorus*
cottongrass - *Eriophorum* spp.
cottonwood, narrow-leaved - *Populus angustifolia*
cottonwood, plains - *Populus deltoides*
cranberry, bog - *Vaccinium vitis-idaea*
cranberry, low bush - *Viburnum edule*
crowfoot, water - *Ranunculus* spp.
devil's-club - *Oplopanax horridum*
dewberry - *Rubus* spp.
dock, sand - *Rumex venosus*
downingia, Great Basin - *Downingia laeta*
dropseed - *Sporobolus cryptandrus*
endolepis - *Atriplex suckleyi*
evening-primrose, obscure - *Oenothera andina*
everlasting - *Antennaria* spp.
feathermoss - *Hylocomium splendens*, *Pleurozium schreberi*, *Ptilium crista-castrensis*
fern, oak - *Gymnocarpium dryopteris*
fern, rock - used here to refer to species of *Woodsia*, *Polypodium* and *Dryopteris*
fescue - *Festuca* spp.
fescue, Idaho - *Festuca idahoensis*
fescue, rough - *Festuca scabrella*
fir - *Abies* spp.
fir, balsam - *Abies balsamea*
fir, Douglas - *Pseudotsuga menziesii*
fir, subalpine - *Abies lasiocarpa*
flag, western blue - *Iris missouriensis*
fleabane - *Erigeron* spp.
foxtail - *Hordeum jubatum*
foxtail, water - *Alopecurus aequalis*
globeflower - *Trollius albiflorus*
goldenweed, one-flowered - *Haplopappus uniflorus*
grama, blue - *Bouteloua gracilis*
grass, American dune - *Elymus mollis*
grass, bearded wheat - *Agropyron trachycaulum* var. *unilaterale*
grass, Indian rice - *Oryzopsis hymenoides*
grass, intermediate oat - *Danthonia californica*
grass, June - *Koeleria macrantha*
grass, manna - *Glyceria* spp.
grass, northern reed - *Calamagrostis inexpansa*
grass, northern wheat - *Agropyron dasystachyum*
grass, oat - *Danthonia* spp.
grass, Parry's oat - *Danthonia parryi*
grass, pine - *Calamagrostis rubescens*
grass, porcupine - *Stipa spartea*
grass, reed - *Calamagrostis* spp.
grass, Richardson needle - *Stipa richardsonii*
grass, salt - *Distichlis stricta*
grass, salt meadow - *Puccinellia nuttalliana*
grass, sand - *Calamovilfa longifolia*
grass, slough - *Beckmannia syzigachne*
grasses, spear - *Stipa* spp.
grass, spear - *Stipa comata*
grass, tufted hair - *Deschampsia cespitosa*
grass, western wheat - *Agropyron smithii*
grasses, wheat - *Agropyron* spp.
greasewood - *Sarcobatus vermiculatus*
grouseberry - *Vaccinium scoparium*
hawthorn - *Crataegus* spp.
hazelnut - *Corylus cornuta*
heather - *Cassiope* spp. and *Phyllodoce* spp.
heather, sand - *Hudsonia tomentosa*
heather, white mountain - *Cassiope* spp.
heather, yellow - *Phyllodoce glanduliflora*
honeysuckle - *Lonicera dioica*
horsetail - *Equisetum* spp.
iris, western blue - *Iris missouriensis*
joe-pye-weed - *Eupatorium purpureum*
juniper, creeping - *Juniperus horizontalis*
juniper, Rocky Mountain - *Juniperus scopulorum*
kobresia - *Kobresia* spp.
lady's-thumb - *Polygonum lapathifolium*
larch, alpine - *Larix lyallii*
larch, western - *Larix occidentalis*
lily, pygmy water - *Nymphaea tetragona*

lily, yellow pond - *Nuphar variegatum*
locoweed, hare-footed - *Oxytropis lagopus*
maple, Manitoba - *Acer negundo*
maple, mountain - *Acer glabrum*
marigold, mountain - *Caltha leptosepala*
meadowrue - *Thalictrum venulosum*
milfoil, water - *Myriophyllum exalbescens*
milkweed, green - *Asclepias viridiflora*
milkwort, sea - *Glaux maritima*
mosses, brown - *Aulacomnium, Drepanocladus &* *Tomenthypnum* spp.
mosses, feather - *Hylocomium, Pleurozium & Ptilium* spp.
mosses, peat - *Sphagnum* spp.
muhly, plains - *Muhlenbergia cuspidata*
ninebark - *Physocarpus malvaceus*
nut-grass, sand - *Cyperus schweinitzii*
oatgrass, Hooker's - *Helictotrichon hookeri*
osier, red - *Cornus stolonifera*
pea, scurf - *Psoralea lanceolata*
phlox, moss - *Phlox hoodii*
pine - *Pinus* spp.
pine, jack - *Pinus banksiana*
pine, limber - *Pinus flexilis*
pine, lodgepole - *Pinus contorta*
pine, whitebark - *Pinus albicaulis*
pondweeds - *Potamogeton* spp.
poplar - *Populus* spp.
poplar, balsam - *Populus balsamifera*
povertyweed - *Iva axillaris*
quillwort, bristle-like - *Isoetes muricata*
rabbitbrush - *Chrysothamnus nauseosus*
rhododendron - *Rhododendron albiflorum*
rose - *Rosa* spp.
rush, needle - *Eleocharis* spp.
rush, three-square - *Scirpus americanus*
rush, wire - *Juncus balticus*
rush, wood - *Luzula* spp.
rye, hairy wild - *Elymus innovatus*
sage, long-leaved - *Artemisia longifolia*
sagebrush - *Artemisia cana*
sagebrush, big - *Artemisia tridentata*
saltbush, silver - *Atriplex argentea*
samphire - *Salicornia europea*
sarsaparilla, wild - *Aralia nudicaulis*
saskatoon - *Amelanchier alnifolia*
scheuchzeria - *Scheuchzeria palustris*
sea-blite - *Suaeda calceoliformis*
sea-blite, Moquin's - *Suaeda moquinii*
sea-milkwort - *Glaux maritima*
sedge - *Carex* spp. sedge, awned - *Carex atherodes*
sedge, beaked - *Carex rostrata*
sedge, Nebraska - *Carex nebrascensis*
sedge, black - *Carex nigricans*
sedge, water - *Carex aquatilis*
silverberry - *Elaeagnus commutata*
skunkbush - *Rhus trilobata*
smartweed, water - *Polygonum coccineum* or *amphibium*
spangletop - *Scholochloa festucacea*
spiderwort, western - *Tradescantia occidentalis*
spike-rush, creeping - *Eleocharis palustris*
spruce - *Picea* spp.
spruce, black - *Picea mariana*
spruce, Engelmann - *Picea engelmannii*
spruce, white - *Picea glauca*
strawberry - *Fragaria virginiana*
sundew, linear-leaved - *Drosera linearis*
tamarack - *Larix laricina*
tea, Labrador - *Ledum groenlandicum*
twinflower - *Linnaea borealis*
umbrella-plant - *Eriogonum flavum*
valerian - *Valeriana sitchensis*
verbena, sand - *Abronia micrantha*
water-lily, pygmy - *Nymphaea tetragona*
wigeon-grass - *Ruppia maritima*
willow - *Salix* spp.
willow, arctic - *Salix arctica*
willow, Barratt's - *Salix barrattiana*
willow, Bebb - *Salix bebbiana*
willow, peach-leaved - *Salix amygdaloides*
willow, snow - *Salix nivalis*
yucca - *Yucca glauca*

6.4 Technical Terms

Aeolian - Applied to deposits arranged by the wind, as the sands and other loose materials in dune fields.

Alluvial - Pertaining to deposits resulting from modern, flowing water (and streams) not primarily influenced by glacial meltwaters, also 'fluvial'.

Alluvium - Deposits resulting from operations of modern rivers.

Arête - Acute and rugged crest of a mountain range, ridge between mountains, or mountain spur.

Beach ridge - A mostly continuous mound of beach material behind the present beach that has been heaped up by wave or other action, commonly created in Alberta during past times of higher lake levels.

Bog - A nutrient-poor, organic wetland not influenced by mineral groundwater, developing an acidic peat forming a level, raised or sloping surface with raised hummocks and wet hollows, usually covered by a moss carpet dominated by Sphagnum spp. and supporting a layer of ericaceous shrubs, with or without trees.

Braided stream - A stream flowing in several dividing and reuniting channels, forming an interlacing pattern because of obstruction by sediment.

Brunisol - A moderately developed soil intermediate in character between Regosols and Luvisols or Podzols.

Chernozem - A mineral soil with an organic-rich, surface layer developed under grasslands or grassland-forest edges.

Cirque - A broad, cliff-walled basin in the mountains in which a glacier has originated and which has been remodelled by ice action and intense weathering.

Clastic rock - A consolidated sedimentary rock composed of the cemented fragments broken down from pre-existing rocks of any origin by chemical or mechanical weathering; e.g., conglomerate, sandstone, shale.

Col - A saddle or gap across a ridge or between two peaks.

Collapse sink - A cavern so enlarged by solution and erosion that it has locally collapsed, an example of karst topography.

Colluvium - A general term applied to loose and incoherent deposits, typically along steeper slopes, and brought there chiefly by gravity, without the intervention of channelled flowing water.

Competent - Refers to rock strata able to withstand folding without flowage or change in original thickness.

Conglomerate - A cemented clastic rock containing gravel or pebbles.

Crag-and-tail - A streamlined hill or ridge, resulting from glaciation and consisting of a knob of resistant bedrock (the "crag"), with an elongate body (the "tail") of more erodible bedrock or till, or both, on its lee side.

Crevasse filling - A relatively straight ridge of stratified sand and gravel, till or other sediments, formed by the filling of a crevasse in a stagnant glacier which later melted. Compared with an esker, it is generally wider and with a flatter top, and not as winding or branching.

Cryosol - A soil with permafrost within 1 m of the surface.

Disjunct - Refers to species found in a locality which is widely separated from other areas of its distribution.

Drumlin - A streamlined hill or ridge of glacial drift with the long axis paralleling the direction of flow of a former glacier.

Dystrophic - A type of lake found in bogs, characteristically brown coloured from a high concentration of humic materials, with low pH, low oxygen concentration in deeper areas, high CO_2, and low nutrient levels.

Eroded plain - A plain comprised of a mosaic of glacial or glaciofluvial landforms and exposed bedrock, usually arising due to reworking of old deposits by intense water action.

Esker - A serpentine-shaped ridge composed mainly of irregularly bedded gravel and sand, mostly deposited by subglacial meltwaters flowing in tunnels near the bottom of glacial ice. An ice-contact feature, commonly associated with kames.

Eutrophic - A generally shallow lake, rich in nutrients, with an extensive zone of emergent and submergent plant growth.

Fan - A fan-shaped accumulation of debris deposited by a stream (fluvial fan) or by gravity (colluvial fan) usually where the slope changes from a steeper to a more gradual angle, as at the base of a valley wall or slope.

Fen - A nutrient-rich, organic wetland influenced by mineral-bearing groundwater, developing a poorly to moderately decomposed peat but often well decomposed near the base, with a circumneutral to slightly alkaline pH. The surface is generally level and uniform, occasionally with subparallel ridges or slightly elevated islands, linear drainage features and dispersed small pools, usually covered predominantly with brown mosses, sedges, grasses and often scattered willow and birch shrubs or trees.

Fibrisol - An Organic soil with relatively undecomposed organic matter which comprises at least 30% by weight of the soil to a depth of at least 60 cm. These develop mainly in poorly drained peatlands.

Flark - A wet depressional area in a patterned fen.

Flora - The plant species of an area, a qualitative list, contrast with vegetation, adj. floristic.

Flowstone - Deposits of calcium carbonate accumulated on a rock wall where water trickles from the rock.

Flute - An asymmetrical scalloped rock surface.

Fluvial - Pertaining to deposits by flowing water.

Forest - Any area wooded with trees, interchangeable with woodland.

Glacial erratic boulder train - A series of widely separated large rocks deposited over a long distance, indicative of former glacial action.

Glaciofluvial - Pertaining to deposits by streams flowing from glaciers.

Glaciolacustrine - Pertaining to materials deposited on the bottom of a pro-glacial lake.

Gleysol - A soil with less than 30 centimetres of organic accumulation (dense type), or less than 60 centimetres (peat type) developed where there is prolonged water saturation resulting in reducing conditions.

Ground moraine - A flat to undulating moraine of low relief, closed depressions and without pronounced topographic features, from material deposited from a glacier on the ground surface over which the glacier has moved.

Hanging valley - A tributary valley whose floor is higher than the floor of an adjoining trunk valley in the area of junction.

Hibernaculum - Overwintering den for snakes, often in cavities in badlands.

Hoodoo - Pillar-like formation in badlands.

Horn - A high pyramidal peak with steep sides formed by the intersecting walls of three or more cirques.

Hummocky moraine - Strongly undulating knob and kettle topography produced by either active or stagnant glacial ice.

Ice contact stratified drift - Drift exhibiting both sorting and stratification, and making up forms such as kames and eskers deposited in contact with melting glacier ice.

Igneous dike - In this report refers to igneous rock that has intruded into and cut across the structure of adjacent softer sedimentary strata. The softer strata have been eroded away, leaving the more resistant igneous rock exposed, usually in a wall-like form.

Incompetent - The converse of competent. Incompetent and competent are relative terms. An incompetent bed is relatively weak.

Kame - A short, steep-sided, irregular ridge, hill or mound of stratified drift deposited by meltwater in contact with glacier ice. Kame moraine - A group of interconnecting kames, including, in places, kettles and eskers.

Karst - A type of topography formed within limestone, dolomite or gypsum by dissolving or solution, and that is characterized by closed depressions or sinkholes, caves and underground drainage.

Kettle - A depression in glacial deposits formed by the melting out of ice blocks which were partially or completely buried in the glacial deposits.

Klippe - An isolated block of rocks separated from the underlying rocks by a fault, typically though not necessarily, with a gentle dip (i.e. a thrust fault)

Lacustrine - Pertaining to materials deposited at the bottom of a lake.

Levee - A natural bank which confines a stream to its channel

Loess - A soft, homogeneous, nonstratified deposit consisting predominantly of silt particles deposited by wind.

Lowland - A relative term, used variously in each Section, to indicate lands that are at lower elevation or more poorly drained.

Luvisol - A moderately-leached soil developed under forest vegetation.

Marl - Deposits of clay and calcium or magnesium carbonate.

Marsh - Circumneutral to alkaline wetland with little peat accumulation, periodically inundated up to a depth of two meters or less with standing or slow-moving water, and often with pronounced seasonal fluctuating water levels exposing

mudflats and matted vegetation at water drawdowns. Vegetation consists of non-woody emergent plants such as bulrushes, cattails, sedges, reeds, rushes or grasses. Often interrupted by channels or pools of open water.

Meander scar - Crescentic cut in the landscape bordering a stream.

Meandering stream - A stream characterized by S-bends and loops, with numerous abandoned channels in the form of oxbow lakes.

Mesotrophic - A lake type which is intermediate in character between oligotrophic lakes and eutrophic lakes.

Metasediment - Metamorphosed sedimentary rock.

Moraine - Drift or till deposited by direct glacial action without subsequent reworking. Moraine plateaux - Generally subcircular, flat-topped mesa-like mounds composed of till and/or stratified drift.

Morainal veneer - A thin covering of morainal material.

Muskeg - A broad term referring to organic terrain, includes both bogs and fens.

Nunatak glaciolacustrine deposit - Material deposited in lakes on the surface of a glacier.

Oligotrophic - A lake which is usually deep, lacks extensive emergent vegetation and is poor in dissolved nutrients and high in dissolved oxygen.

Organic - Surface deposits composed of partly decomposed peat, also a soil type developed where there is peat accumulation due to poor drainage and saturated conditions.

Oxbow Lake - A crescentic water body formed from a meander of a stream which has been cut off.

Outwash - Drift deposited by meltwater streams issuing from and discharging beyond, or adjacent to, glacier ice.

Paleodune - In this case, referring to a now stabilized but once formerly extensive and active dune.

Palsa - A low flat-topped mound of peat, ice and, rarely, mineral soil occurring on bogs in the discontinuous permafrost zone, most common in the Subarctic Section.

Patterned ground - A group term for the more or less symmetrical forms such as circles, polygons, nets, steps and stripes that are characteristic of areas which have been subject to intensive frost action.

Parabolic dune - A dune type with a crescentic shape and the points facing into the direction of the prevailing wind.

Pediment - A gently inclined erosion surface, here used to refer to gentle slopes at the base of steeper slopes in badlands.

Periglacial - Refers to features adjacent to the margin of a glacier.

Peripheral - Applied to species which barely extend their ranges into Alberta. Areas of peripherality have numerous peripheral species.

Piping feature - Tubular vertically-oriented features formed by water erosion within bedrock in badland areas.

Plateau - A relatively elevated area of comparatively flat land which is commonly limited on at least one side by an abrupt descent to lower land.

Podzol - a soil with highly-leached upper horizons generally developed under coniferous forest or ericaceous vegetation or noncalcareous parent material.

Proglacial - Applied to features of glacial origin beyond the limits of the glacier itself.

Pseudokarst - A large piping feature.

Regosol - A soil with weakly developed surface horizons usually because of recent deposition or erosion of the surface.

Residuum - Material derived from weathering of bedrock and left largely in place.

Rill - Small channel in a badland slope, a micro-drainage feature.

Roche moutonnée - Glacially eroded bedrock knob.

Sinkhole - A funnel-shaped depression in the land surface, characteristic of karst topography, communicating with a underground passage developed by solution.

Sinking creek - An example of karst topography where a stream disappears underground.

Slump block - Here used to indicate any type of landform where the slide mass remains virtually intact after it has moved downslope by gravitational action.

Solifluction - The process of slow movement from higher to lower ground of masses of surface material saturated with water.

Solonetz - A grassland soil type with a salinized sub-surface horizon or hard pan layer.

Solution sink - See sinkholes and karst.

Swamp - Wooded, circumneutral to moderately acid wetland, with standing to gently flowing water occurring seasonally or persisting for long periods on the surface, and often with an abundance of pools and channels. Vegetation cover is more than 25 per cent coniferous or deciduous trees or tall shrubs, as well as herbs and mosses. Associated with stream courses, lake edges, subsurface drainage, glacial depressions and bog margins.

Talus - Coarse debris that has collected at the base of a steep slope by colluviation, a kind of colluvium.

Tarn - A small mountain lake or pool, especially one that occupies an ice-gouged basin on the floor of a cirque.

Terrace - The former floodplain of a stream, also used occasionally as including an active floodplain.

Thermokarst - Topography with a pock-marked appearance in northern landscapes, created by collapse of permafrost features.

Thrust fault - A reverse fault in bedrock, characterized by a low angle of uplift.

Till - Non-sorted, non-stratified sediment carried by a glacier.

Transverse dune - Linear-shaped dunes aligned at right angles to the prevailing wind.

Tufa - A chemical sedimentary rock composed of calcium carbonate or of silica, deposited from solution in the water of a spring or lake, or from percolating ground water.

Upland - A relative term, used variously in each Section, to indicate lands that are at higher elevation or better drained.

U-shaped Valley - A valley carved by glacial erosion, having steep sides and a characteristic rounded profile.

Vegetation - The plant communities of an area, a quantitative description, contrast with flora, adj. vegetational.

Woodland - Any area wooded with trees, interchangeable with forest.

7.0 APPENDIX

7.1 Geology - Provincial Overview

This overview is intended to provide an overall perspective of the landscape character of the province through a discussion of its geology. In particular, those features which have a major influence on the vegetation patterns are discussed. It does not provide a detailed discussion of landscape-forming processes, although these are addressed where it is felt that further clarification is necessary. For simplification, various aggregations of physiographic units will be used which do not directly relate to any specific Natural Region, but which do share common landscape forming processes. The province includes four basic physiographic regions: Canadian Shield, Plains, Foothills, and Rocky Mountains.

In addition to a portion of the Cordilleran Foothills Belt of disturbed rocks which extends from northern Alberta into the United States, the Foothills Natural Region also includes isolated plateaux and uplands referred to as "Northern Outliers", underlain by undisturbed Cretaceous rock with a Tertiary gravel cap. Foothills (Cretaceous) rocks are also found in parts of the Rocky Mountain Montane, Foothills Parkland, and Foothills Grassland Sections. As many geological processes are common to both the Rocky Mountains and Foothills, these physiographic regions are discussed together.

The term Plains refers to all areas outside the Cordilleran Belt of Rocky Mountains and Foothills, and the Canadian Shield. This includes: the Mixed Grassland, Northern Fescue Grassland, Central Parkland, and Peace River Parkland Sections, and the entire Boreal Forest Natural Region. It also includes the Foothills Parkland and Foothills Grassland Sections and those areas which are classified as Foothills Natural Region but which occur outside the disturbed Cordilleran Belt (principally the Northern Outliers).

Alberta occupies a unique position in North America in that it straddles the western margin of the exposed Precambrian Shield, the Western Canadian Sedimentary Basin, and the eastern Section of the Western Cordillera.

The basic character and framework of the Alberta landscape was established in the long period of geologic history (about 2.5 billion years) that preceded the Pleistocene Age glaciation. Glaciation refined the appearance of the landscape and created many surficial features on which the bulk of the present-day vegetation exists. The land continues to be shaped by the forces of erosion and deposition. However, these effects, while significant ecologically, are of minor importance compared to the influences of the ancient bedrock foundation and the glacial reshaping which occurred in relatively recent times.

Canadian Shield (including Athabasca Plain)

The story of the Alberta landscape begins some 2,500 million years ago. Rocks of this age are the oldest exposed in Alberta and belong to the ancient Precambrian Shield, now exhumed in the extreme northeastern corner of the province. The Shield is a complex of igneous, metamorphic, and sedimentary rocks. The Canadian Shield includes the oldest rocks in all of North America.

The Canadian Shield (Kazan Upland) is characterized by a large proportion (65%) of bedrock outcrop, dominated by

igneous and metamorphic rocks. Only about 10% of the landscape is underlain by glacial deposits. The remainder is made up of lakes and organic deposits in peatlands. Glacial meltwaters from the last retreating ice sheet effectively washed the uplands clean of deposits. The exposed bedrock shows ample signs of recent glacial advance by way of polish, striations, flutes, crescentic chatter marks, roches moutonnRes, and drumlinoid landforms. The terrain shows a pronounced streamlined linear pattern of bedrock topography and surficial deposit shapes, clearly indicating the direction of ice advance. The shape and orientation of lakes, bogs, and intervening ridges all mark the passing of the recent Laurentian Continental glacier.

The largely poorly cemented Athabasca sandstone is of special importance in the Athabasca Plain because of the abundant supply of sand provided to the advancing glaciers. Sand now dominates all forms of glacial deposits, regardless of their origin or form. Consequently, there is very little (less than 5%) bedrock outcrop in the Athabasca Plain. Kames, some which are over 60 m in height, may be the largest in the world.

A notable absence of lakes occurs in a part of the western area south of Lake Athabasca, due to the wide extent of former Glacial Lake Tyrrell and the eastward post-glacial march of sand dunes which have filled in glacial lakes. Active dunes remain in this area, the most spectacular is 10 km across and is burying lakes and forest beneath its 10 m high crest. Northeast of Fort McKay there is a wide area of stabilized and spectacular dunes in longitudinal, parabolic, fish-hook, and other complex combination forms. The predominant storm wind direction appears to have been from the southeast. Today, the storm winds blow from the west. The longitudinal dune forms are considered by some researchers to be classical in quality. Longitudinal dune forms are rare in temperate climates.

Streamlined features such as giant flutings, drumlinoid forms, and crag and tail resulted from the ice flow within the continental ice sheet. Typical glacial deposits include: outwash plains with kettle holes, till, drumlins, crevasse fillings, eskers, recessional and de Geer moraines, ice-contact glaciofluvial stream channels beaded with lake deposits, and proglacial lake deposits with long series of stacked abandoned beaches. All of these deposits are sand dominated, derived from the Athabasca sandstones that underlie and are adjacent to Lake Athabasca. Spectacular windblown features associated with these sandy deposits include: sand dunes, sand sheets, facetted boulders (dreikanter), and bedrock with grooves, flutes, and desert polish, generally located to the northwest side (i.e. downwind) of large sandy areas.

Foothills and Rocky Mountains

The Rocky Mountains fold belt represents the disruption resulting from the collision of a westward moving North American plate with the Pacific plate. This ongoing compression has buckled and raised the thick layers of sediments accumulated in successive seas ranging from Cambrian and earlier times into the Cretaceous. Compressional forces raised the ocean sediments to form the Cordillera, represented in Alberta by the Rocky Mountain-Foothills Belt. The relatively undisturbed portion of thinner sediments to the east underlie the present Plains. Superimposed on this bedrock foundation are the later modifying effects of Pleistocene Continental and Cordilleran glaciation as well as post- glacial erosion and deposition.

As the Mountain-Foothills Belt was uplifted and eroded, newly formed and fast, eastward-flowing rivers transported and deposited the erosional debris as massive fans built out onto the adjacent Plains. These fans are now represented by sandstone-dominated bedrock of Tertiary age, extending outwards from the Cordilleran Foothills Belt.

The range in chemical and physical properties of parent surficial sediments (and therefore their soils) derived from different bedrock sources are important factors in determining the distribution of numerous plants. Three major bedrock types crop out in the Rocky Mountains:

1. non-calcareous medium- and coarse-grained clastics (e.g. quartzite and sandstone);

2. non-calcareous, fine-grained clastics (e.g shale); and

3. carbonate (e.g. limestone, dolostone) and calcareous clastics (e.g. calcareous siltstone).

The harder, more resistant Paleozoic rocks (mostly limestone, dolostone and quartzite) are the basis for the prominence of the Main and Front Ranges in the Disturbed Belt. The lower Foothills terrain is comprised of softer Mesozoic sandstones and shales. At least in the central portion of the Rocky Mountains, the Front Ranges are typified by the dominant exposure of steeply southwest dipping Devonian to Jurassic age rocks. Sub-parallel ridges of resistant carbonate peaks are separated by valleys carved from less resistant Mesozoic clastic rocks or faults.

In contrast, the Main Ranges have more gently dipping strata and are arranged in a much less linear (ridge-like) manner than the Front Ranges. These mountains are generally capped by resistant Paleozoic carbonates whereas the valley walls are composed of rocks of Late Proterozoic and Early Paleozoic age. Precambrian sediments thin out in the Ranges south of Calgary and reappear in the Waterton area.

The bedrock formations of the Foothills and Mountains can be classified into two groups based on their physical properties: competent and incompetent. The competent formations (i.e. cliff-formers include the majority of the Proterozoic-Paleozoic rocks, mainly carbonates and quartzites, with only minor interbedded shales. The incompetent rocks are predominantly of Mesozoic age and consist of shales and soft sandstones. Weathering in the Mountain Ranges has produced coarse gravels and the landforms encompass steep slopes and cliffs. In contrast, Mesozoic formations typically weather to finer-grained materials and there is a conspicuous reduction of cliffs in the landscape. As a result, about 60% of the Rocky Mountain landscape exists as bedrock exposure whereas only 10% of the Foothills is exposed bedrock, which includes thrust slices of competent Paleozoic-Proterozoic carbonates and quartzites.

The long ridges of the Foothills parallel those of the Main Rocky Mountain Ranges. Closest to the Mountains, the Foothills are capped by more resistant strata of Mesozoic and thrust Paleozoic rock slices whereas the valleys have been carved in softer Mesozoic and Cretaceous rocks.

The full range of alpine glacial features is represented in the Rocky Mountains including: horns, arStes, cols, cirques, tarns, trim lines, hanging valleys, a variety of moraines, and U-shaped valleys. Oversteepening of the glacial valley sides is common and the consequent slope instability has led to a variety of mass

movement phenomena such as: rock slides, avalanches, soil creep, and landslides.

Canadian Shield crystalline rocks are found in the older tills at several locations along the outer Foothills, signifying that Continental glaciers once advanced along the edge of the Foothills. Older tills of Illinoisan or even older age lie at elevations above 1600 m, indicating that the earlier deposits were laid down during the most widespread glaciation in the Foothills and Rocky Mountains. Young Cordilleran tills are found mainly within the major valleys in the Rocky Mountains and Foothills (Smoky, Athabasca, Brazeau, North Saskatchewan, Red Deer, Minnewanka, Bow, Oldman, Crowsnest, and Waterton valleys). These tills are very stony and have a relatively high carbonate content of 10 to 60%.

Weathering and erosion of the carbonate-cemented Cordilleran tills have led to some spectacular local landscape features such as the hoodoos at Banff where erratics form the resistant cap to earth pillars.

Morainal deposits are extensive in both the Mountains and Foothills. They are medium- to coarse-textured and, in the Mountains, are predominant along valley walls, valley floor benches, cirque basins, and cols. In the Foothills they occur on much of the gentler slopes which are not occupied by alluvium, outwash, or glaciolacustrine deposits.

Glaciofluvial deposits are comprised primarily of gravel with some sand. The most extensive deposits are outwash plains (including valley train and pitted outwash) located along the broad valleys such as the Athabasca, Brazeau, Red Deer, North Saskatchewan, Bow, Livingstone, Crowsnest, Oldman, and Waterton River valleys. Kames are relatively common throughout the Foothills, mainly along the major valleys. They are primarily comprised of well-rounded gravels.

The majority of finer-grained glaciolacustrine deposits are found in the outer Foothills, however, there are minor amounts within the Rocky Mountains. The most notable are found in the slower-moving backwaters of the larger stream valleys (e.g. Vermilion Lakes). Lacustrine deposits in the Foothills are primarily of glacial origin. Aeolian and organic deposits are relatively rare in the Rocky Mountains. However, the sand-dominated glacial deposits have been reworked in some of the valleys, e.g. the sandy shores of Brûlé Lake in the Athabasca River valley. Aeolian deposits are also rare in the Foothills but organic deposits are relatively common, especially in the outer fringes.

Coarse alluvial deposits are present along most major streams in the Foothills and Rocky Mountains. Less common at higher elevations, they are most prevalent in the Montane and lower Subalpine Sections of the Rocky Mountain Natural Region and in the Main Foothills Section. Deposits of glaciofluvial origin are difficult to separate from those of fluvial (post-glacial) origin; the division can be arbitrary. Alluvium composed of sand or finer-grained material is found along smaller streams in the Foothills.

Alluvial fans and cones form where steep gradients of streams enter low-gradient sections, e.g. where tributary streams enter the major valleys in the Rocky Mountains. In some cases, the alluvial fans coalesce to form a continuous alluvial apron. In the Foothills, alluvial fans are much less common than in the Rocky Mountains and have relatively gentle slopes.

Meltwater ponds (proglacial lakes) situated in front of glaciers are commonly drained by fast-flowing meltwater streams. Such streams commonly aggrade the floor of the adjacent upper sections of glacial valleys. Characteristically, these meltwater streams have a braided channel form.

The existing numerous ice-fields and glaciers are remnants of former more extensive complexes of ice-caps and valley glaciers.

Patterned ground is typically found on level to gently sloping terrain in alpine regions above treeline. It is derived from periglacially sorted loose deposits, with coarse surface material commonly arranged in the shape of polygons, stripes, and related forms. Large areas of patterned terrain are relatively rare because of the lack of large flat areas above treeline in mountainous regions.

Colluvium and residuum dominate on steeper slopes in the Rocky Mountains and Foothills. The former is more prevalent in the Foothills Natural Region, and in the Subalpine and Montane Sections of the Rocky Mountain Natural Region, whereas the latter is most common in the Alpine Section. Colluvium is generated by slow downhill creep of the near-surface deposits. It differs from till in that it is derived only from the formations present upslope. Residuum is present on gentler slopes and usually consists of medium-textured materials which have weathered in place and have not been significantly transported downslope. These two types of deposits occupy the largest proportion of all deposits in the Foothills and Rocky Mountains. Solifluction is relatively uncommon except at higher elevations.

Areas of talus are found in the Rocky Mountains where there is an accumulation of coarse rock debris (angular blocks and boulders) derived by frost shattering of cliff-forming bedrock. Large accumulations of talus take the form of cones which may coalesce to from talus aprons at the foot of long ridges. Most talus has been derived from carbonate Paleozoic rocks. Talus derived from quartzite, sandstone, conglomerate, and other siliceous rock types is relatively uncommon and present mainly along the divide where early Paleozoic and Proterozoic quartzites crop out. Talus of schistose rocks is present in parts of Willmore Wilderness Park. Talus is generally uncommon in the Foothills.

Slump block terrain is characterized by step-like topography in the upper slopes and by mud and earth flows at the base. It is most prevalent in the outer portions of the Foothills.

Plains

Whereas the Foothills, Rocky Mountains, and Canadian Shield strongly reflect their bedrock characteristics at the surface, the Plains owe much of their surface character to events connected with glaciation. Glacial features evidenced in the Plains include: a variety of moraines, glacial lake basins, pitted deltas, meltwater channels and spillways, dune fields, glacially contorted bedrock, esker-kame complexes, giant flutings, ice-plucked lake basins (hill and hole topography), and outwash plains. In the Plains, only the upper surfaces of the Cypress Hills and Porcupine Hills, and lower Foothills areas remained unglaciated during the last major ice advance.

These glacial features are all relatively recent modifications of an ancient almost flat-lying landscape. The composition of glacial till was affected directly by the bedrock over which the

ice sheets passed. In traversing Alberta the Continental glacier crossed from crystalline Canadian Shield rocks onto Athabasca sandstone, Devonian carbonates, and Cretaceous shales and soft sandstones. Each of these terrains contributed materials, the influence diminishing with distance from the various source areas.

The components of the glacial deposits over much of the Plains are derived from the soft Cretaceous bedrock. However, in the far north, there are significant contributions to the glacial deposits from Devonian carbonates and Athabasca Group sandstone. Less than 5% of the Plains consist of exposed bedrock and these areas are largely confined to valley walls and plateaux slopes.

Because the receding ice-front retreated downslope toward the northeast in Alberta, both meltwaters and mountain runoff were impounded at the ice front, creating an extensive system of proglacial lakes and ice- contact glaciofluvial deposits. As the proglacial lake basins filled they overflowed, forming spillway channels. Proglacial lakes were very extensive across the entire Plains region and are evidenced by their characteristically flat appearance, despite post-glacial dissection and gully development. The gradual lowering of glacial lake levels led to the development of concentrically arranged abandoned beaches (strand lines); an outstanding example can be seen on the west side of Lake Claire in northeastern Alberta. The system of proglacial lakes and fluvial channels shifted laterally as the ice front migrated downslope towards the northeast.

The ice front retreated in a pulse-like manner creating a series of recessional moraines. At an intermediate stage of deglaciation, an ice- free corridor existed between the retreating Continental ice front to the northeast and the Cordilleran ice sheets to the west. This configuration played a major role in the direction from which plant and animal communities became re-established.

Immediately after ice retreat and draining of the meltwaters, concentrated in glaciofluvial channels and glaciolacustrine beach and deltaic deposits, extensive areas of bare, unvegetated sand, were exposed to storm winds. Hence, the formation of widespread dune deposits was a direct result. Of note is the fact that Alberta has more dune areas than the rest of Canada combined. The abundance of sand in glacial deposits is a direct consequence of the extensive bedrock sources of sand, found primarily in the easily eroded Athabasca Group sandstone and the Cretaceous soft sandstones. The latter provided materials for large volumes of glaciolacustrine and glaciofluvial deposits on the Plains which were laid down when meltwaters became confined at the retreating ice front.

Events of the last glaciation have left the Plains with a highly disorganized drainage system. As a consequence, Alberta, particularly in the north, has some of the most extensive and diverse wetlands in all of Canada. Areas of internal drainage are common.

Dissected Tertiary plateaux, comprised of flat-lying sedimentary strata, are situated along the outer edge of the Main Foothills Section and form the Swan Hills and Porcupine Hills. Other Tertiary remnants exist in the Cypress, Hand, and Wintering Hills. The flat-topped plateaux of the Swan, Hand, Wintering, and Cypress Hills, as well as several other hills in the north, are capped with Tertiary fluvial gravels and boulders. These plateaux are only small remnants of what was once a higher extensive plain. Other highlands in the north, such as the Caribou Mountains, Buffalo Head Hills, and those uplands which form the most northern portion of the Foothills Natural Region (as defined for purposes of this report) owe their existence, at least in part, to a resistant bed of Cretaceous sandstone. The surrounding soft shaley Cretaceous sediments have been worn away more quickly leaving upland areas behind.

Karst topography is found over widely scattered areas in the Rocky Mountains, near Fort McMurray, and in Wood Buffalo National Park. The latter encompasses some of the most widespread and continuous karst development in Alberta. Karst formation is still active at these northern sites.

During the post-glacial period, new drainage systems have developed on the Plains. Stream erosion has cut into the veneer of glacial deposits and locally exposed the underlying bedrock. A wide range of river valley features is found along the major modern drainage systems, including: channel bars, oxbow lakes, meander loops, meander scars, levees, flood plains, terraces, abandoned channels, and slumps.

One of the most spectacular fluvial depositional features in Alberta is the Peace-Athabasca River delta, the largest freshwater delta in the world. This delta complex features migrating distributary channels which have built a classic birdsfoot delta system into Lake Claire and Lake Athabasca.

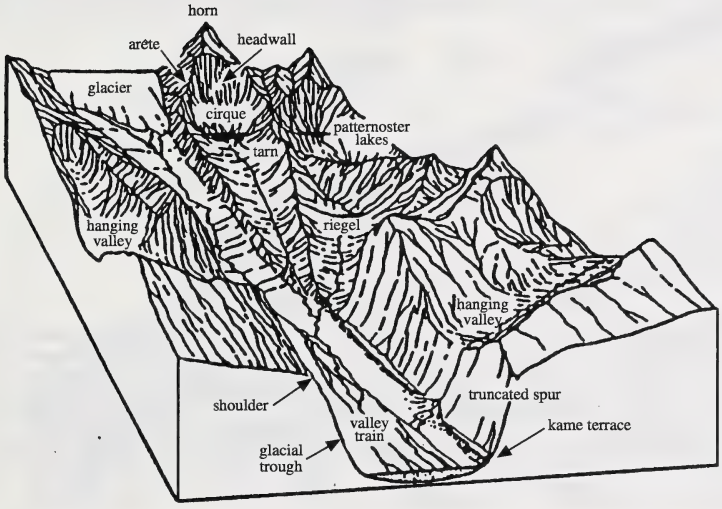
Extensive badlands have formed in several of the major river valleys of the southern Plains where the Cretaceous bedrock in the valley walls is directly exposed to weathering. The best-developed and most extensive areas are along the Red Deer River at Dinosaur Provincial Park and in the Milk River Canyon. Elsewhere, badlands are more limited in extent, occurring as only narrow bands along stream or spillway channel walls. A variety of badland forms can be found, including: pediments, knife- edge divides, mudflows, pseudokarst, piping features, hoodoos, and rills. Differences in vegetation correlate with three broad classes of bedrock - shale, soft sandstone, and massive sandstone (channel sands).

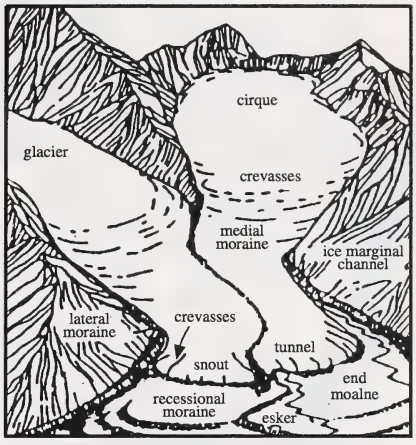
One of the more subtle, large-scale features of the Plains relates to the pre-glacial drainage channels which now constitute a system of buried river channels. Glacial deposits have covered and filled in the pre-existing topography, including the pre-glacial river systems. However, because of the greater compaction of the thicker glacial deposits in the deeper river valleys, they are now visible as wide shallow depressions at the Plains surface. Many of these buried stream channel-related depressions have influenced the position of the post-glacial modern stream channels.

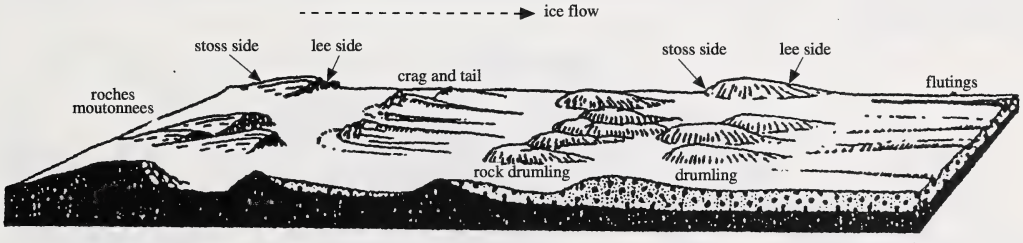
7.2 Geological Time Scale

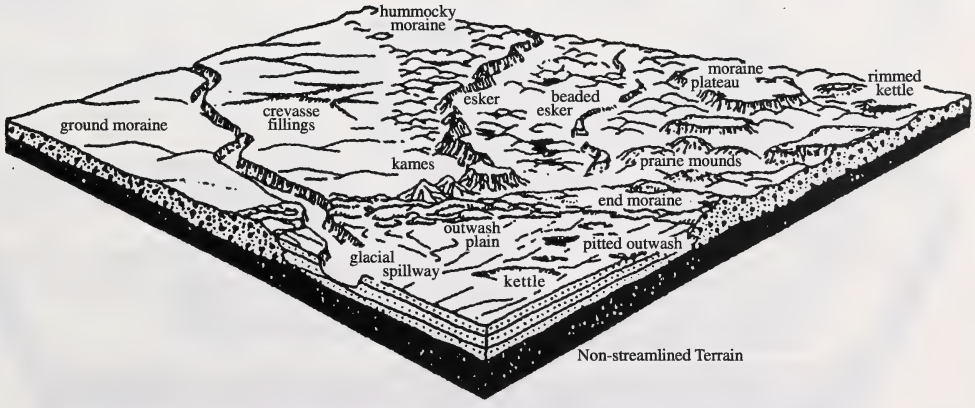
			Years Before Present
CENOZOIC	**Quaternary**	Recent	0
		Pleistocene	10 thousand
	Tertiary	Pliocene	2 million
		Miocene	13 million
		Oligocene	25 million
		Eocene	36 million
		Paleocene	58 million
MESOZOIC	**Cretaceous**		65 million
	Jurassic		135 million
	Triassic		190 million
PALEOZOIC	**Permian**		225 million
	Pennsylvanian] or		280 million
	Mississippian] Carboniferous		320 million
	Devonian		345 million
	Silurian		395 million
	Ordovician		430 million
	Cambrian		500 million
PRECAMBRIAN	**Proterozoic**		570 million
	Archeozoic		2.4 billion
ORIGIN OF THE EARTH			4.5 billion

MOUNTAIN GLACIATION FEATURES



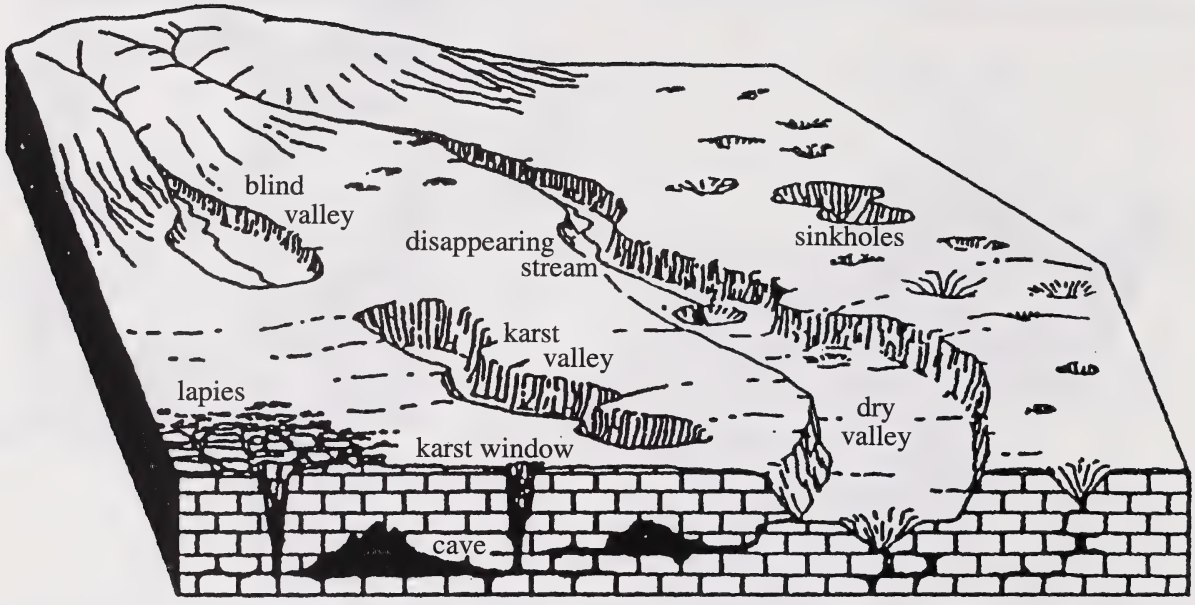




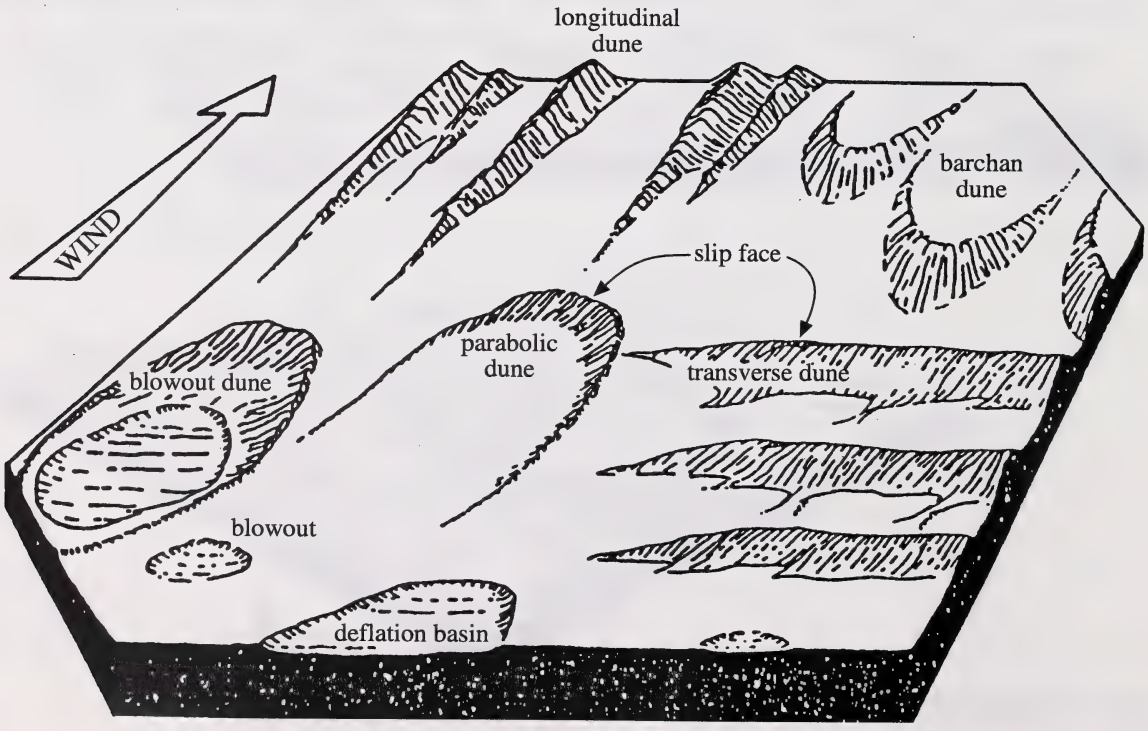


CONTINENTAL GLACIATION FEATURES

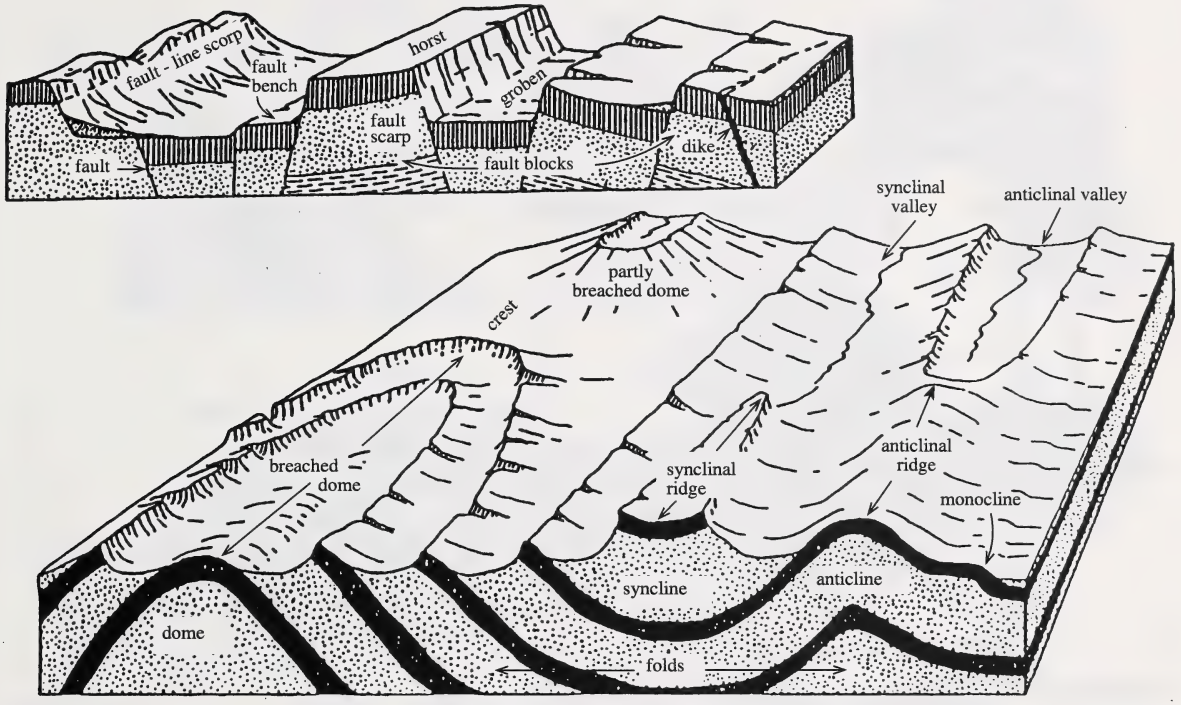
KARST FEATURES

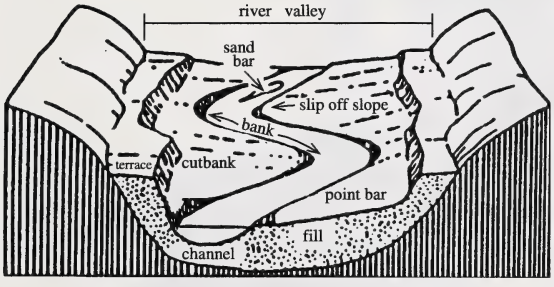


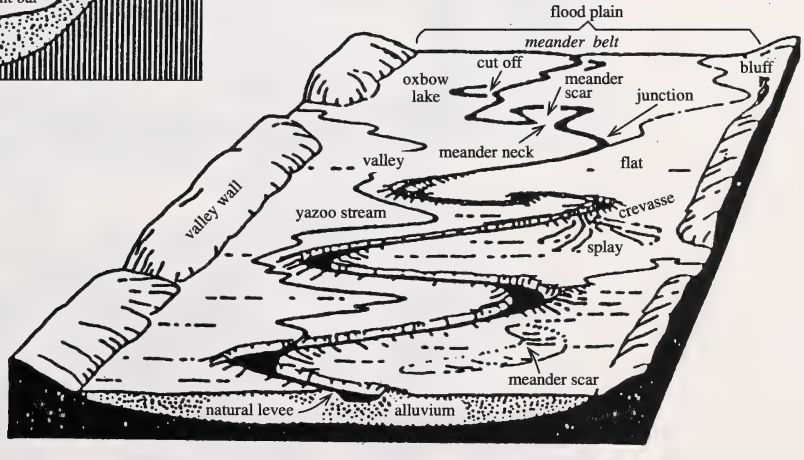
EOLIAN FEATURES



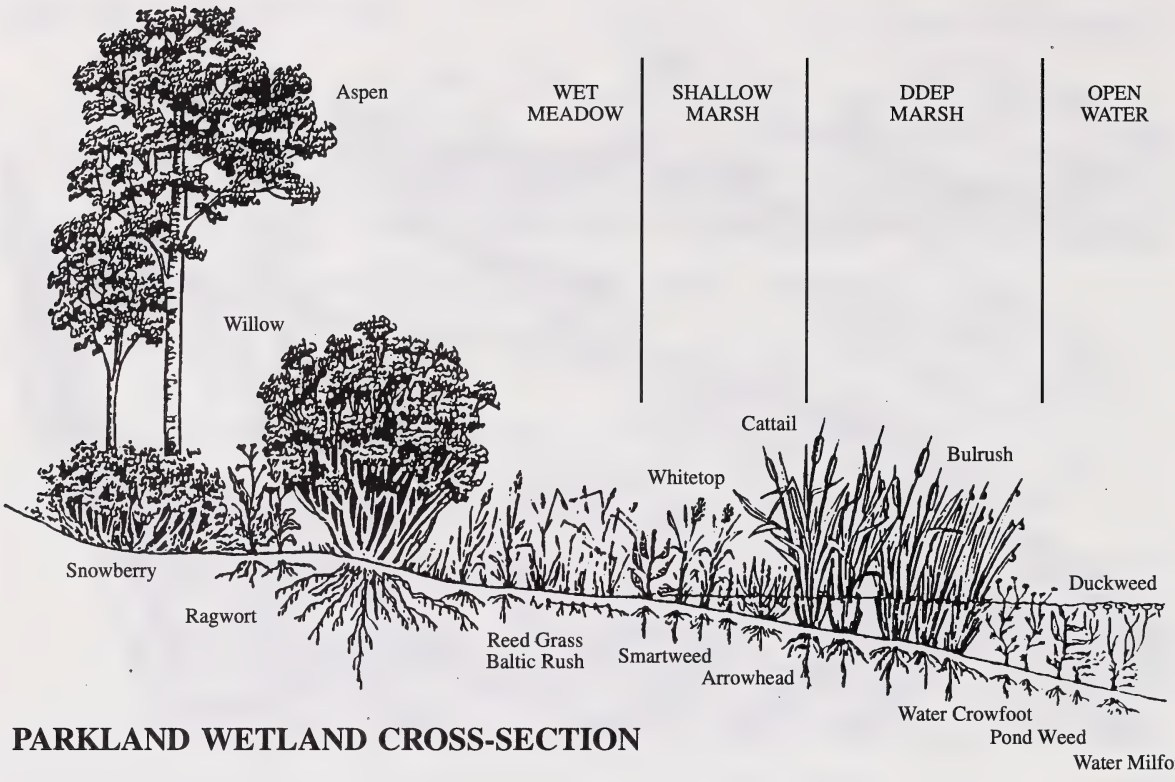
STRUCTURAL FEATURES



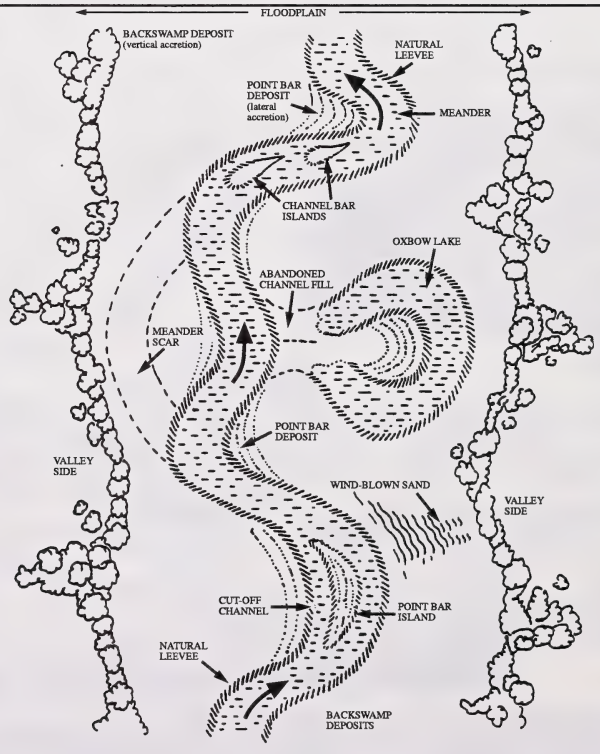




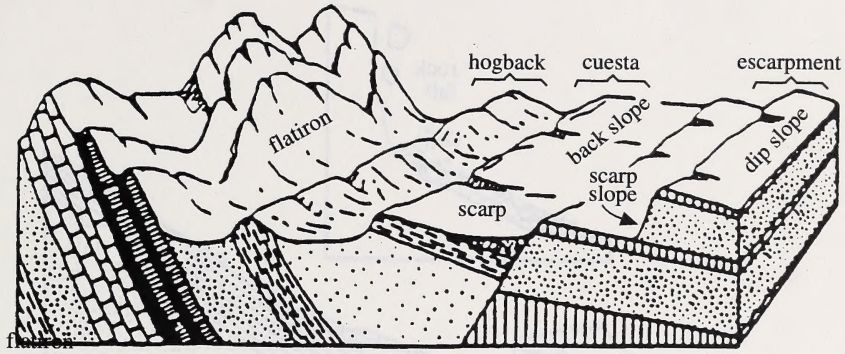
FLOODPLAIN (Fluvial) FEATURES (a)

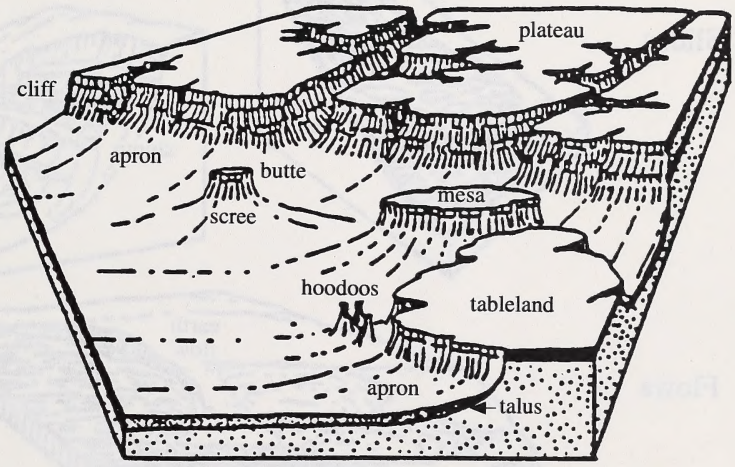


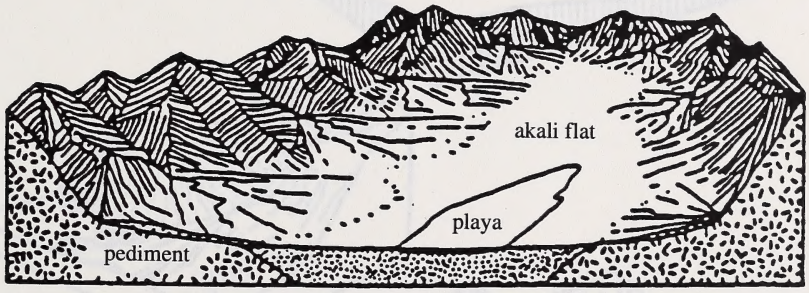
PARKLAND WETLAND CROSS-SECTION

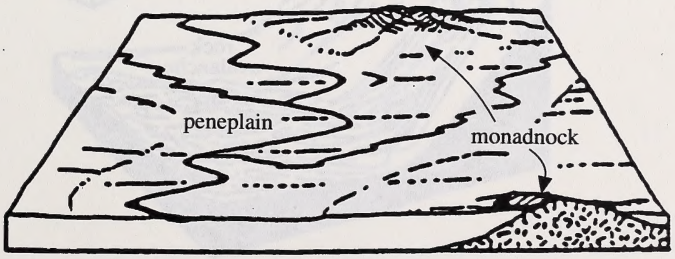


FLOODPLAIN (Fluvial) FEATURES (b)

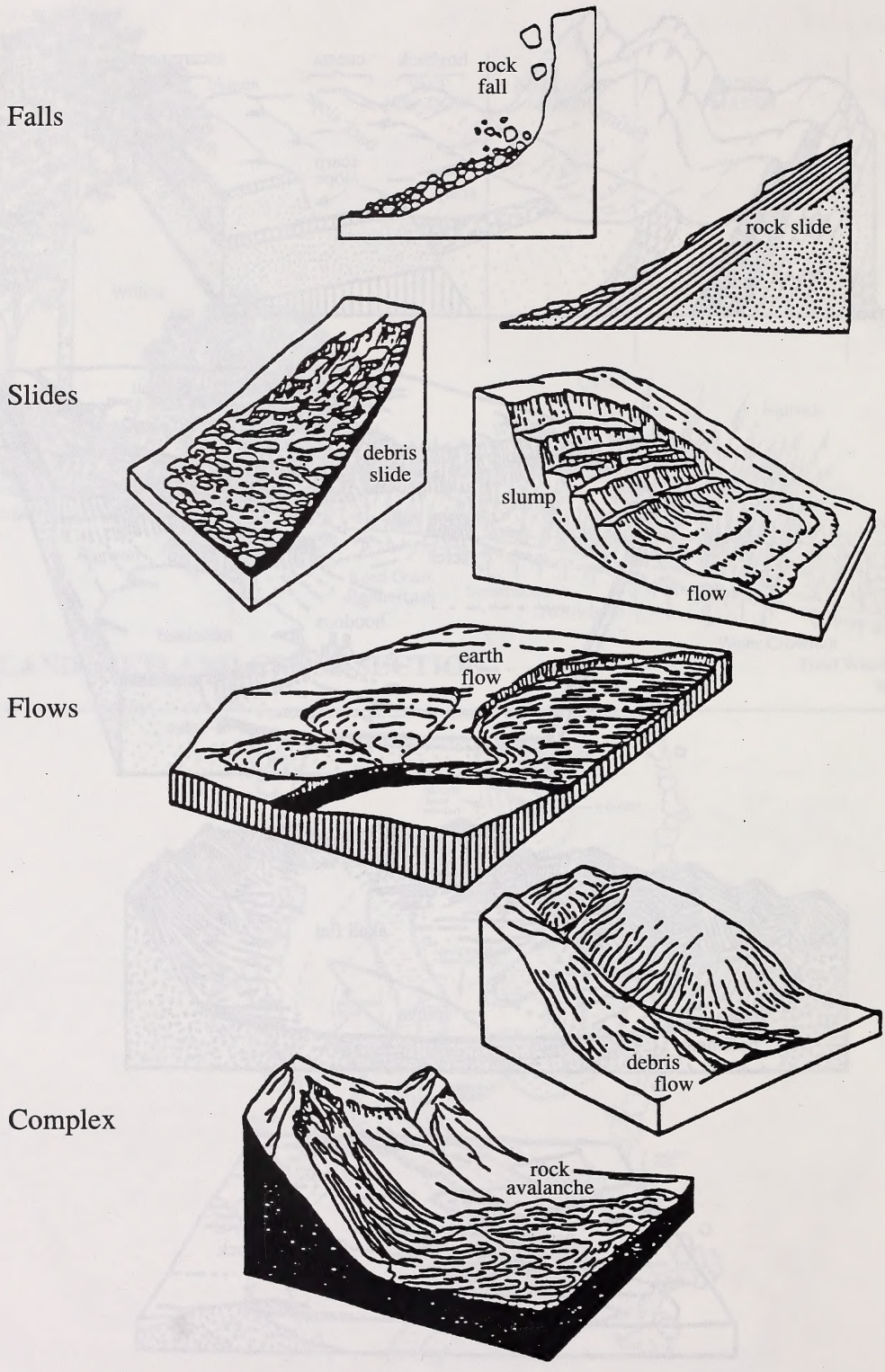








WEATHERING AND EROSIONAL FEATURES



MASS MOVEMENT FEATURES

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